

**Computer Components and Operations
(ECSE-2610)
Spring 2025**

Class Companion Website

<https://dylanrees.github.io/coco/>

This site will be kept up to date with links to course documents and teaching staff office hours and contact info.

Class Meeting Times & Locations

Meeting Type	Time	On-campus Location
Lectures	10am-11:50am Tue, Fri	Sage 3303
Lab Section 01	12pm-1:50pm	JEC 6309
Lab Section 02	3pm-4:50pm	JEC 6309
Lab Section 03	5-6:50pm	JEC 6309
Office Hours	See Website	See Website

Overview (Catalog Description)

Design-oriented introduction to computer components and operations. Standard codes, number systems, base conversions, and computer arithmetic. Boolean algebra, minimization and synthesis techniques for combinational and sequential logic. Races, hazards, and asynchronous behavior. Registers, arithmetic logic units, memory structure, buses, and control units. Machine language programming, instruction fetch and execution, input-output devices, interrupts, and microprogram sequencers. Software and hardware tools.

Student Learning Outcomes

The students who finish this course in a satisfactory manner will be able to demonstrate:

- 1.) Convert among various digital numeric representations (decimal, binary, hexadecimal, 2's-complement).
- 2.) Analyze Boolean expressions and logic circuits to determine outputs from inputs and inputs from outputs.
- 3.) Understand, categorize, design, and simulate combinatorial and sequential logic circuits.
- 4.) Design, synthesize, debug, implement, and test combinatorial and sequential logic circuits, using FPGA-based hardware.

Prerequisites

CSC1 1100 – Computer Science I (prerequisite)

Suggested Textbook

1. John F. Wakerly, Digital Design: Principles and Practices, 4th or 5th Edition, Prentice Hall. (Book website: <https://wakerly.org/DDPP/index4e.html>)

Required Software

1. Xilinx Vivado Design Suite 2016.2 (Installation instructions on shared drive)
2. LogicWorks 5 (<https://www.designworkssolutions.com>) (this may change – TBA)

Grading

Unit 1 Exam	(20%)
Unit 2 Exam	(20%)
Unit 3 Exam / Final Exam	(20%)
Homework Assignments	(10%)
Studios	(20%)
HDL Assignments	(5%)
Metacognition	(5%)

Alpha Labs vs. Omega Labs

(Sections 1 and 3 adapted from Prof. Shayla Sawyer's Omega Labs guide for ECSE 2010.)

Section 1: What are Omega Labs?

Omega Labs are a design-based alternative to the traditional “Alpha Labs”, which are procedure-based. In most classes, labs are a set of instructions that you follow and report on with an academic journal-style paper. But this isn't what a real-world engineering job is like; most engineers need to come up with their own design and write user manuals and datasheets.

In Omega Labs, you will have the freedom to design your own circuit based on what you have learned in the course. The requirements of the reports and evaluations of projects will be based on what is generally expected in a job.

Omega Labs emphasize personal growth, learning from failure, planning, and iterative design. You will not be graded only on the overall functionality of the project. Instead, your grade will be based partially on your ability to meet your goals and incorporate feedback into your project and partially on the functionality of individual building blocks of the circuit and your ability to analyze them.

Section 2: How do Omega Labs Work?

Omega Labs are broken into Studios A, B and C, each of which corresponds to a set of concepts. During each Omega Lab studio, you will be expected to design a digital circuit that utilizes building blocks representing concepts taught during the lectures and previous studios. In some cases, additional building blocks may be offered that were not covered in the main course material.

Section 3: Are Omega Labs Right for You?

Unlike Alpha Labs, Omega Labs are not consistent, straightforward, and predictable in terms of difficulty and time. Omega Labs are potentially unpredictable and require you to be more involved. However, Omega Labs provide many things Alpha Labs do not: the freedom to build whatever you want and the chance to practice what engineers really do: design. To decide which Lab is best for you, think about your time constraints for the rest of the semester and what classes you're taking. Consider too that you could use your Omega-Lab project in another class or independent study. Think about how you learn best as well - do you need a structured assignment to learn, or do you do best by diving in and creatively applying the concepts?

Section 4: Switching Between Alpha and Omega Labs

You don't have to do Omega Labs for the entire semester – you can switch between Alpha and Omega Labs at specified times according to your preference. The switch may be made at the beginning of a new Omega Lab module. For instance, Omega Studio B begins in week 10 of the course. At this point, students completing Omega Studio A may switch back to Alpha Labs (and work on Studio 5) while Alpha Labs students who are completing Studio 4 may switch into Omega labs and start Studio B.

Section 5: Grading Omega Labs

You will not be graded only on the overall functionality of your entire circuit; If your whole circuit does not work, you may not lose any points from your lab grade. However, each individual building block must be functional on its own. One purpose of this design lab is to give you a safe space to try new things and fail. By not grading you on the functionality of the whole circuit, we hope to encourage exploration and to allow you to experience and learn from failed designs.

You will be graded based on your progress (have you met your goals, incorporated feedback, and do you know what needs to be done next), your technical accomplishments (functionality of building blocks, design decisions, communication in manual), and your Proof of Concepts (demonstrating how your design shows mastery of concepts covered in class). The grade distribution is meant to distribute the grade evenly between analysis, design, and progress.

General Assessment Policies

- Homework is due in Gradescope by 11:59pm on the due date. There will be no quizzes on exam days. Quizzes are open-book and open-notes.
- Assignments are submitted on Gradescope and are due by **11:59pm** on the designated due date. Late assignments will not be accepted unless an official excuse is provided. Please plan accordingly and communicate directly with me via email if serious circumstances prevent you from completing assignments. While collaboration in homework is encouraged, obvious copying of homework from another person will result in a grade of 0 points and potential sanctions due to academic dishonesty.
- Homework and exam grades may be appealed by submitting a regrade request on Gradescope. These are due within 7 days of when the grades are published on Gradescope.

Accessibility Statement

Rensselaer Polytechnic Institute strives to make all learning experiences as accessible as possible. I will strive to provide an environment that is equitable and conducive for learning for all students. Please contact me as soon as possible if you:

2) anticipate or experience academic barriers based on a disability. To establish reasonable accommodations, please register with The Office of Disability Services for Students. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. To receive any academic accommodation, you must be appropriately registered with DSS.

1) Require remote work accommodations. Although Rensselaer has mostly resumed its pre-pandemic operations, I anticipate that on a few occasions during the semester, a student will be required to isolate due to COVID or may be unable to attend class for other personal reasons. Under such circumstances I can arrange for a student to attend my lecture remotely. I can also provide a remote option for exams, but I expect you to reach out ahead of time in order for me to arrange this. Lectures will also be recorded for access outside of class.

DSS contact information: dss@rpi.edu ; 518-276-8197, 4226 Academy Hall.

Diversity, Equity and Inclusion Statement:

I will strive to provide an environment that is equitable and conducive to achievement and learning for all students. I ask that we all be respectful of diverse opinions and of all class members, regardless of personal attribute. I ask that we all use inclusive language in written and oral work, and in the classroom. School of Engineering (SoE) and Electrical, Computer and Systems Engineering (ECSE) policy is that no students, faculty and staff shall be excluded on the grounds of gender, race, class, religion, sexuality, disability, etc. The free exchange of ideas, as well as diversity of background, experience and views contributes to the learning experience, and further broadens and adds strength to our learning community. All participants in this course are encouraged to recognize the diversity around them and are expected to treat their classmates and instructor with respect. We strive to create a learning community of mutual respect and trust, where people are valued and heard without the threat of bias, harassment, intimidation, or discrimination.