

## **ECCS 3241: Embedded hardware software codesign**

### **Course description:**

CMOS circuit design, area-delay-power tradeoffs; microprocessor/digital signal processor/network processor instruction sets, bus-based system design, embedded computing platform; software/program design and analysis, hardware-software partitioning, hardware accelerators; networks and distributed embedded architectures, system design techniques, multicore embedded systems; integrated laboratory experimental activities. Offered spring semester.

### **Instructor information:**

Semester:	Spring
Year:	2025
Instructor:	Dr. Firas Hassan
Office:	JLK 266
Class Schedule:	M W F 11:00 am ~ 11:50 am JLK 322
Lab Schedule	T: 8:00am~10:45am, JLK 313
Office Hours:	M at 10 &13, T at 12 &13, W at 13, F at 10
Phone:	419-772-2393
E-mail:	f-hassan@onu.edu
Website:	Canvas will be used as our primary means of distributing course information.
Final exam:	Monday, May 12, 11:45 am to 1:45 pm

### **Textbook (recommended)**

**Computers as Components: Principles of Embedded Computing System Design** , The Morgan Kaufmann Series in Computer Architecture and Design, 5th Edition, by Marilyn Wolf Ph.D. Electrical Engineering Stanford University.

### **Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the operation of CPU buses, I/O devices and interfacing to design an embedded computer platform.
2. Understand program design and models of programs.
3. Understand real-time operation of embedded systems and the use of real-time operating systems.
4. Understand distributed embedded network architectures.
5. Demonstrate hardware/software co-design to develop a custom embedded platform and application.
6. Design CMOS transistor circuits understanding the physical layout parameters.
7. Perform delay-speed-power tradeoffs in CMOS digital circuits.
8. Be able to implement and synthesize digital designs on FPGAs
9. Research and make an oral presentation and write a report on a topic related to the embedded and/or computing systems.

**Course Topics:**

The list below is tentative and subject to change:

**PART 1: HARDWARE PLATFORM**

1. Instruction Set Architectures
2. Bus operation, Data Converters, I/O Device, and Memory Interfacing
3. Embedded Computer Platform Design
4. Hardware Security and Trust

**PART 2: SOFTWARE AND SYSTEM DESIGN**

1. Software Design
2. Program Analysis and Compilation Analysis
3. Real-time Operating Systems

**PART 3: CMOS DESIGN**

1. MOSFET Operation
2. CMOS Fabrication Process and Layout
3. Transistor level Design of CMOS Circuits
4. Logical Effort
5. FPGA Structures

**Grading:**

Homework	15%
Lab	15%
Midterm exam	25%
Final Exam	30%
Research project	15%

**Homework Assignments policy:**

- Homework will be regularly assigned and collected at the beginning of class on Monday. Homework solution will be discussed in class and published on the class website on Monday.
- Students are encouraged to discuss approaches and ideas for homework problems with each other, and are expected to acknowledge such collaboration in writing. Copying another student homework solution or solutions generated by AI is considered academic dishonesty and will be penalized.

**Laboratory Assignments policy:**

- Laboratory assignments are a graded portion of the course. The work is to be totally your own and your laboratory partner. Collaboration on laboratory assignments will be treated the same as collaboration on an examination. On examinations it will be considered cheating and on laboratory assignments it will be considered cheating.
- You are supposed to keep the lab space as clean as possible.

**Exams policy**

- Plan ahead so that you can avoid any conflicts with these important dates.
  - Midterm Exam will be given in week 8
- Both exams are in-class

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- Exams are open book and electronic notes are allowed but no AI or any sort of external help during exams.

#### **Research topic policy**

- Last week of classes is reserved for presentation on advance topics in embedded hardware software codesign
- You will be working on this topic in groups of 2 or 3 and you will select your topic around week 10.
- You will also submit an individual report that relates the topics covered in the course to current technology.

#### **Common Course Policies**

Ohio Northern University is dedicated to providing an equitable educational experience for all enrolled students. Universal course policies applicable to all courses can be found at the following link: [https://my.onu.edu/registrars\\_office/policies](https://my.onu.edu/registrars_office/policies).

#### **Snow Emergency:**

If there is a snow emergency and we fall behind schedule, I will upload the materials to Canvas. You'll be asked to review them and complete an online quiz to confirm your understanding of the content.