

# EECS 388 – Embedded Systems

## 4 Credit Hours – Fall 2022

### Course Description

An embedded system is an intelligent system with special-purpose computation capabilities. You can see examples of embedded systems every day in smart appliances, cars, medical devices, etc. In this course, you are going to learn about the hardware and software architecture of embedded systems. At the end of the course, you will learn to program a microprocessor to interact with the physical world through sensors and actuators. This course is divided into two parts: lectures and labs. Lectures will teach you the theory about embedded systems, and in the labs, you will implement what you learned during the lectures. Here is a (tentative) list of the topics that we will cover in the lectures:

- 1- Introduction to embedded systems: what is an embedded system and the differences between embedded systems and general-purpose computers.
- 2- Embedded software ecosystem: Introduction to tools and environment for developing embedded software (build toolchain, GNU make, IDEs, git).
- 3- C programming refresher: a brief introduction to C.
- 4- RV32 ISA: a brief introduction to RISC-V assembly language.
- 5- Microprocessor's memory address space.
- 6- I/O (sensors and actuators): how to interact with the physical world using sensors and actuators
- 7- Interrupt: Difference between interrupt and polling, how to use them, and the implications of using them.
- 8- Concurrency and threads: how to utilize the available parallelism in the hardware and develop concurrent embedded software.
- 9- Scheduling: Real-time scheduling concepts in Linux.
- 10- CPU and memory architecture: Learn how instructions get executed in the hardware. Studying the micro-architecture of a basic RISC-V, single-cycle processor.

### Recommended Textbooks

You do not need to study any textbook for this course. However, here is a list of textbooks that you may find helpful to understand the topics better. Please consult with me to give you exact pointers for which chapters in these textbooks are relevant to which topic.

- "Introduction to Computing Systems: From Bits and Gates to C and Beyond" by Y. Patt, S. Patel (any edition)
- "AVR Microcontroller and Embedded Systems: Using Assembly and C" by M. Mazidi, Sa. Naimi, Se. Naimi (any edition)
- "Computer Organization and Design, a Hardware/Software Interface" by D. Patterson, J. Hennessy (any edition)
- "[Introduction to Embedded Systems – A Cyber-Physical Systems Approach](#)" by E. Lee and S. Seshia

### Class Meetings

#### Lecture

Tuesdays and Thursdays

Time: 11:00 AM – 12:15 PM

Classroom: EATN 2

**Labs**

Mondays

8:00 – 9:50AM or 2:00 – 3:50PM

Tuesdays

8:00 – 9:50AM or 1:00 – 2:50PM

Wednesdays

8:00 – 9:50AM or 2:00 – 3:50PM

Thursdays

8:00 – 9:50AM

Fridays

8:00 – 9:50AM

Room: [EATN 3002](#)

## Course Staff

**Instructor**

Dr. Mohammad Alian

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Email: [alian@ku.edu](mailto:alian@ku.edu)

OH: (right after class) Tu 12:15 – 1:00 PM, Th 12:15-1:00 PM

**Graduate Teaching Assistants (GTAs)**

Soma Pal

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**Grader:**

Naga Chandrika Indlamuri

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## Course Website and Discussion Forum

We use Canvas for posting grades and announcements. We use Microsoft Teams for discussion. The lecture notes and course materials will be posted to the course website:

[Http://eecs388.ku.edu](http://eecs388.ku.edu)

## In-Class Quizzes, Homework and Grading

We will have in-class quizzes during the lecture. These quizzes help you be focused during the lecture, encourage you to study the topics gradually throughout the semester, allow me to gauge your understanding before taking exams, and most importantly, help you solidify your learning. To allow you to miss a few quizzes due to any circumstances over the course of the semester, **15% of the in-class quizzes are bonus points.**

We will have a few homework during the semester.

Quizzes and Homeworks: 15%

Midterm: 20%

Final: 25%

Lab: 40%

Attendance: note required, but you'll lose the in-class quiz points! (please check the attendance policy) \*

## Lab Instructions

In EECS388 labs, you will learn how to use microcontrollers and embedded processors for interacting with the physical environment using I/O devices. Here are the (tentative) labs topics:

- Introduction to the embedded software development environment
- C-programming
- UART
- Sensor reading
- Servo motor control
- Timers
- Introduction to embedded Linux
- Real-time DNN inference
- Self-driving car

Each student needs to attend one lab session every week.

## Academic misconduct

Students should not share their quiz answers, lab code, and lab report with others or copy other students' code or reports. In the case of plagiarism, we follow the university policy for academic misconduct: <https://policy.ku.edu/governance/USRR#art2sect6>

## Attendance policy

Attendance is mandatory for lab sections. You can miss class lectures, but you'll also miss the in-class quiz points.

## Late submission

There is no late submission policy for in-class quizzes. The late submission policy for the lab assignments will be included in the lab handouts.

## Covid related

Please check [The Protect KU](#) site regularly for policy updates regarding COVID.

## Accommodations for Disabilities

The Student Access Center coordinates academic accommodations and services for all eligible KU students with disabilities. If you have a disability for which you wish to request accommodations and have not contacted SAC, please do so as soon as possible. They are located at 22 Strong Hall and can be reached at 785-864-4064. Information about their services can be found at [www.access.ku.edu](http://www.access.ku.edu). Please contact me if you need help in this course.

## Diversity and Inclusion

The University of Kansas supports an inclusive learning environment in which diversity and individual differences are understood, respected, and appreciated. We believe that all students benefit from training and experiences that will help them to learn, lead, and serve in an increasingly diverse society. All members of our campus community must accept the responsibility to demonstrate civility and respect for the dignity of others. Expressions or actions that disparage a person's or group's race, ethnicity, nationality, culture, gender, gender identity/expression, religion, sexual orientation, age, veteran status, or disability are contrary to the mission of the University. We expect that KU students, faculty, and staff will promote an atmosphere of respect for all members of our KU community. This is an inclusive classroom. At KU, administrators, faculty, and staff are committed to the creation and maintenance of "inclusive learning" spaces. These are classrooms, labs, and other places of learning where you will be treated with respect and dignity and where all individuals are provided equitable opportunities to participate, contribute, and succeed. Please discuss any reason that might exclude you from having a safe and supportive learning environment in this class with the me.