EECS 388: Embedded Systems

4 Credit Hours – Spring 2023

- **Instructor:** Tamzidul Hoque, Assistant Professor, Dept. of EECS, University of Kansas (hoque@ku.edu), office: Eaton 2038

- **Lecture Time and Location:** Tu/TH 1:00PM - 2:15 PM, LEEP2 2300

- **Course Summary:** Embedded systems are special-purpose computation devices. We can find embedded devices inside smart phones, smart watches, cars, drones, medical devices and in many other applications. This course will introduce the hardware and software aspect of the embedded systems. Hardware architecture will cover internal architecture of processor and use of peripheral and sensors. In software side, we will learn about the methods to create and execute software applications on embedded devices. 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 echo-system: 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. Networking: Ethernet and TCP/IP networking software stack.
  11. CPU and memory architecture: Learn how instructions get executed in the hardware.
  12. Security aspects of hardware

- **Textbooks:** There is no required textbook but there are three books that I plan to use as reference:
  1. Introduction to Embedded Systems - A Cyber-Physical Systems Approach, by Edward Ashford Lee and Sanjit Arunkumar Seshia
  2. Introduction to Computing Systems, 3/e Yale N. Patt, The University of Texas Austin Sanjay J. Patel, University of Illinois at Urbana-Champaign
  3. AVR microcontroller and embedded system (Muhammad Ali Mazldl, Sarmad Nalml Sepmr Nalml)

- **Teaching Assistants (TA) and Supplementary Instructors (SI):**
    - Soma Pal: soma_pg2021@ku.edu (TA)
    - Mojahidul Ahsan,: smmojahidul.ahsan@ku.edu (TA)
    - Sm Ishraq-Ul Islam: ishraq@ku.edu (TA)

- **Lab time and location:**

Time		GTA NAME
Tu 09:00 - 10:50 AM EATN 3002 - LAWRENCE		Soma
Th 09:00 - 10:50 AM EATN 3002 - LAWRENCE		Ishraq
M 10:00 - 11:50 AM EATN 3002 - LAWRENCE		Ishraq
F 01:00 - 02:50 PM EATN 3002 - LAWRENCE		Soma
M 03:00 - 04:50 PM EATN 3002 - LAWRENCE		Ahsan
W 03:00 - 04:50 PM EATN 3002 - LAWRENCE		Ahsan

- **Office hours:**
    - Tamzidul Hoque: TBD
    - Office hours of TA:
    - Soma: TBD
    - Ishraq: TBD
    - Ahsan: TBD

- **Course Website and Discussion Forum:**
    - Canvas

- **Grading-methods of evaluation**
    - Homework: 10%
    - In class quiz: 5%
    - Midterm: 20%
    - Final: 25%
    - Lab: 40%
        - *(Weekly labs 25% + final project: 15%)*

- **Grading Scale**

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
93<=	[89-93)	[86-89)	[83-86)	[79-83)	[76-79)	[73-76)	[69-73)	[66-69)	[63-66)	[59-63)	<59

- **Tentative dates of exams:**
    - Midterm: 3/8/2023: during class
    - Final Exam: 5/9/2023: 1:30 – 4:00 p.m.

- **Late submission:**

    - For homework, 30% marks will be deducted each day after the deadline has passed. After that no submission will be accepted. In person quizzes have no late submission option. If you are likely to miss a quiz or homework due to medical or other serious emergency, it must be notified **before** the deadline with proof acceptable to the instructor.

- **Lecture Recording:** Lecture recordings are not guaranteed to be made available for all classes. Therefore, attend the class in person.

- **Make-up exam policy for finals:** https://registrar.ku.edu/final-exam-policies

- **Exam accommodation policy:** http://access.ku.edu/exam-accommodations-0

- **Honesty Policy:** Plagiarism and unauthorized assistance related to any submission of this course is strictly prohibited. Please follow the Ethical writing guideline: https://writing.ku.edu/academic-integrity

- **Lab Instructions**
    - Each student needs to attend one lab session every week.
    - In EECS388 labs, you will learn how to use microcontrollers and embedded processors for interacting with the physical environment using I/O devices. This is the (tentative) labs topics:
        - - Introduction with the embedded software development environment
        - - C-programming
        - - UART
        - - Sensor reading
        - - Servo motor control
        - - Timers - Introduction to embedded Linux
        - - Linux scheduler
        - - Real-time DNN inference
        - - Self-driving car

- **Lab policies:** Please refer to the lab syllabus.