**EEL4709C - Computer Design**

Three Credits, One and half hour, Engineering Topic.

**Instructor:** Dr. Atoussa Tehrani.


**Specific Course Information:**
This is an undergraduate-level course which covers the fundamentals of computer organization and hardware-software interaction. The course presents the main functional units of a computer on how they are built and how they function. Since the course is intended to serve students with a background in Computer or Electrical Engineering, prior knowledge of logic design is expected. This includes a binary numbering system, combinational and sequential logic design. Topics covered in this course include computer system, CPU, computer programming, input/output and memory.

This course will consist of 5 modules. Module availability is open; however, students are expected to complete each module by the due date. Students must submit their assignments by the due date specified on the course portal. Submitted assignments will be evaluated within one week of submission. At the end of the course, you would have learned the fundamentals of a computer system and have had hands-on experience to set up and program a Raspberry Pi computer.

**Specific Goals for the Course**

a. **Specific outcomes of instruction**

Upon successful completion of this course, the student will:

1. Identify the design aspects of all elements that constitute a complete computer, including CPU, bus design, memory and input/outputs.
2. Examine ARM processors and system on the chip.
3. Write computer programs to explain hardware-software interaction.
4. Classify the characteristics of computer memory system, memory hierarchy, memory types Cache, ROM, RAM, and external memory.
5. Describe input/output operation techniques, programmed I/O and interrupt driven I/O and direct memory access.
6. Setup Raspberry Pi peripherals including GPIO, UART, ADC, PWM, SPI, and I2C.
7. Construct applications using a Raspberry Pi computer.

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

In this course the student will have to show

(a) an ability to apply knowledge of mathematics, science, and engineering (X)
(b) an ability to design and conduct experiments (simulations), as well as to analyze, interpret data (X)
(c) an ability to design a system, component, or process to meet desired needs (X)
(d) an ability to function in multi-disciplinary teams (X)
(e) an ability to identify, formulate, and solve engineering problems (homework) (N/A)
(f) an understanding of professional and ethical responsibility (N/A)
(g) an ability to communicate effectively (through project reports) (X)
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context (X)
(i) a recognition of the need, and an ability to engage in life-long learning (N/A)
(j) a knowledge of contemporary issues (X)
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (X)
(l) a knowledge of probability and statistics (N/A)

**Brief list of the topics to be covered**
1. The Von Neumann architecture and the major components in a computer system
2. Computer system performance assessment, Amdahl’s law
3. CPU design, instruction fetch/decode/execute, pipelining, bus interconnection
4. Memory hierarchy and cache memory
5. Internal/external memory
6. I/O devices, interrupt, DMA
7. Integer/Float point representation and arithmetic
8. Characteristics and function of instruction set architecture
9. Assembly programming
10. Parallel and distributing computing

**GRADING:**

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**Conversion of Numerical Grade to Letter Grade**

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