

1. *Course number and name*

ENGR 478: Design with Microprocessors

2. *Credits and contact hours*

4 credits

Contact hours: two 75-minute lecture sessions/week and one 2-hour-45-minute lab session/week

3. *Instructor's or course coordinator's name*

Instructor: Xiaorong Zhang, Assistant Professor of Computer Engineering

Course coordinator: Xiaorong Zhang, Assistant Professor of Computer Engineering

4. *Text book, title, author, and year*

“Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, Fifth Edition (Volume 1)”, Jonathan Valvano, 2012

a. *other supplemental materials*

Lab material:

- Tiva C Series TM4C123G LaunchPad Evaluation Kit (EK-TM4C123GXL)

Other references:

- Tiva TM4C123GH6PM Microcontroller Data Sheet
- Getting Started with the Tiva TM4C123G LaunchPad Workshop Student Guide and Lab Manual
- TivaWare Peripheral Driver Library User's Guide
- Tiva C Series TM4C123G LaunchPad Evaluation Board User's Guide.
- Cortex-M4 Technical Reference Manual
- Cortex-M4 Devices Generic User Guide
- Cortex-M3/M4F Instruction Set Technical User's Manual

5. *Specific course information*

a. *brief description of the content of the course (catalog description)*

Basic microprocessor/microcontroller architecture. Assembly and C language programming. System bus and interfacing with memory and I/O devices.

Serial and parallel communications. Timer and counter functions. Polling and interrupt. Analog-to-digital and digital-to-analog conversion. Three-unit class work; one-unit laboratory work.

b. *prerequisites or co-requisites*

ENGR 356 with a grade of C- or better; ENGR 213 with a grade of C- or better or CSC 210 with a grade of C or better

- c. *indicate whether a required, elective, or selected elective course in the program*
Required for Computer and electrical Engineering.

6. *Specific goals for the course*

- a. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*

Students completing the course successfully will demonstrate

- an in-depth knowledge of a microprocessor/microcontroller.
- an ability to program in assembly and C language
- knowledge of the interactions between software and hardware.
- an ability to integrate software and hardware for microprocessor-based systems.
- an ability to interface microprocessor with other devices through serial and parallel I/O.
- an ability to deal with analog signals in digital systems.
- an ability to use timer and counter functions.
- an ability to design an expanded system by adding external circuits as required.
- an ability to use development tools.
- a skill in troubleshooting a microprocessor-based system.

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

Course addresses ABET Student Outcome(s): a, b, c, e, g, j, k.

7. *Brief list of topics to be covered*

- Introduction to embedded systems
- Introduction to TM4C123GH6PM microcontroller and
- ARM Cortex-M4 architecture and assembly language
- Assembly syntax; Functions; Logic operations
- GPIOs
- Friendly software development in C
- Switch and LED interfacing; IO synchronization
- Interrupt concept and nested vectored interrupt controller
- Edge-triggered interrupt and periodic interrupt
- Analog to digital conversion (ADC)
- Digital to analog conversion (DAC)
- Serial communication
- Serial I/O – SSI vs. UART vs. USB vs. I2C

- Power management
- Advanced Topic in Embedded System Design.