

CSE 379
Introduction to Microprocessors
Spring 2020
4 Credit Hours

Instructor: Dr. Kris Schindler

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Course E-Mail: cse-379@buffalo.edu

All course related concerns and correspondence should be sent to cse-379@buffalo.edu

Office: Davis 346

Phone: (716) 645-3185

Office Hours:

Monday 10:00 AM - 10:50 AM

Wednesday 12:00 PM - 12:50 PM

Friday 10:00 AM - 10:50 AM

Additional times by appointment

Any changes to office hours during the semester will be posted to the class website and announced in class.

Class Time:

Monday/Wednesday/Friday 9:00 AM - 9:50 AM

Class Location:

Knox 4

Labs:

R1 Monday / Wednesday 11:00 AM - 12:20 PM

R2 Tuesday / Thursday 11:00 AM - 12:20 PM

R3 Tuesday / Thursday 2:00 PM - 3:20 PM

R4 Tuesday / Thursday 3:30 PM - 4:50 PM

Lab Location:

Bonner 114

Prerequisites:

CSE 241, EE 178, or equivalent

Description:

This is an introductory course in microprocessors and microprocessor based systems specifically addressing microprocessor architecture, assembly language programming, and microprocessor system design and interfacing.

Topics covered include: microprocessor concepts, instruction set architecture, memory design and interfacing, input/output concepts, interrupt and exception handling, timing considerations, the ARM AMBA standard, and system design techniques. The ARM microprocessor is used to convey these topics.

Textbook:

- Kris Schindler, *Introduction to Microprocessor Based Systems Using the ARM Microprocessor*, Second Edition, Pearson, 2013

Processor:

- Tiva C Series TM4C123G LaunchPad Evaluation Kit

Trainer Board:

- EduBase ARM Trainer All-In-One ARM BaseBoard for Tiva™ LaunchPad, Version 2

Objectives:

The objectives of this course are to:

- Give students an understanding of how a microprocessor is organized and designed
- Familiarize students with how microprocessors function
- Introduce assembly language programming, microprocessor system design techniques, memory system design, serial I/O, parallel I/O, and the ARM AMBA standard.

Outcomes:

At the end of this course, each student should be able to:

- Understand how a microprocessor is organized
- Write ARM assembly language programs that interface with memory and peripherals
- Design a memory subsystem for an ARM-based microprocessor system
- Design an ARM-based microprocessor system for a control application

References:

- William Hohl, *ARM Assembly Language Fundamentals and Techniques*, CRC Press, 2009
- ARM Ltd., *Cortex-M4 Devices Generic User Guide*, DUI0553A, ARM, 2010
- ARM Ltd., *ARM® and Thumb®-2 Instruction Set Quick Reference Card*, QRC0001, ARM
- Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi, *Programming ARM Corect-M4 TM4C123G with C*, First Edition, MicroDigitalEd, 2014-2016
- Texas Instruments Incorporated, *Tiva™ TM4C123GH6PM Microcontroller Data Sheet*, June 12, 2014, Texas Instruments – Production Data, 2007-2014
- Andrew N. Sloss, Dominic Symes, and Chris Wright, *ARM System Developer's Guide - Designing and Optimizing System Software*, Morgan Kaufmann, 2004
- Steve Furber, *ARM System-on-chip Architecture*, Second Edition, Addison-Wesley, 2000
- Jonathan W. Valvano, *Embedded Systems: Introduction to ARM® Cortex™-M Microcontrollers*, Volume 1, Fifth Edition, 2017
- Brian W. Kernighan and Dennis M. Ritchie, *The C Programming Language*, 2nd Edition, Prentice Hall, Inc., 1988
- David A. Patterson and John L. Hennessy, *Computer Organization and Design, The Hardware/Software Interface*, ARM® Edition, Elsevier, 2017
- <http://www.arm.com>
- *Additional references may be sited throughout the semester*

URL:

<http://www.cse.buffalo.edu/~kds/cse-379/>

Class Participation:

Class participation is strongly encouraged.

Grading Policy:

- Evaluation:
 - Exam #1- 10 %
 - Exam #2 - 10 %
 - Final Exam - 10 %
 - Quizzes - 5 %
 - Projects - 65 %
- Letter grades are assigned using the following criteria. The average referenced is calculated using the breakdown shown above (*Evaluation*).
 - A: average ≥ 93.333
 - A-: $93.333 > \text{average} \geq 90$
 - B+: $90 > \text{average} \geq 86.667$
 - B: $86.667 > \text{average} \geq 83.333$
 - B-: $83.333 > \text{average} \geq 80$
 - C+: $80 > \text{average} \geq 76.667$
 - C: $76.667 > \text{average} \geq 73.333$
 - C-: $73.333 > \text{average} \geq 70$
 - D+: $70 > \text{average} \geq 66.667$
 - D: $66.667 > \text{average} \geq 65$
 - F: $65 > \text{average}$
- At the end of the semester, a curve may be applied to help the class, but not hurt the class. The grading breakdown above represents a worst case scenario. Determination of whether a curve will be applied occurs at the END of the semester after ALL graded components have been graded. Individual components are not curved.
- *Late policy*: Late submissions will result in a 20% penalty per day. A day is defined as 24 hours after the day/time the assignment is due (excluding weekends or school holidays). In addition, no help will be available from the TAs or from the instructor for a project after its scheduled due date. After five (5) school days, the assignment will no longer be accepted.
- A lab practical exam will be administered. You must obtain a passing grade (65%) on the exam. If you do not, you must take a makeup exam. If you do not score a passing grade (65%) on the makeup exam, your programming projects will be prorated by the higher of the two lab practical exams. The lab practical exam only affects your grade if you fail both attempts. If you pass at least one attempt, the grade does not factor into your final average.
- Projects, quizzes, and exams may be submitted for regrades no later than one (1) week after they are returned. The sole exception is when an assignment is returned within seven days of the last class of the semester. In this case, the regrade request deadline will end at the end of the last class of the semester. If you don't pick up the assignment on the day it is returned, that does NOT extend the regrade request deadline. Regrade requests must be made using an online form on the CSE 379 website. Requests made without using this form will not be accepted. This form allows you to enter a detailed description of why the material is being submitted for regrade. It is only available during the regrade period outlined above. Regrade requests are intended to correct grading errors, NOT for negotiating a higher grade. When work is submitted for regrade, the entire work may be regraded. Work done in pencil may not be considered for regrade.

Grading Policy Con't.:

- Homework assignments will also be given, but they will not be graded. They are used to help students become proficient with the material.
- Graded projects, quizzes, and exams will be returned during lecture and/or recitation (lab). If you don't pick it up during that time, it is your responsibility to pick it up during the instructor's office hours as soon as possible.

ABET Outcomes:

This course is intended to meet outcomes 1, 2, 5, 6, and 7 for computer engineering as prescribed by the Accreditation Board for Engineering Technology (ABET).

Computer Usage:

All students are required to have an account on the Computer Science and Engineering Department's Unix/Linux timeshare machines and a UBIT account. These accounts will be used to disseminate information via e-mail & the CSE 379 website. Students are expected to check their e-mail and the CSE 379 website regularly.

Students are encouraged to use the Code Composer Studio software. The software is available on the Texas Instruments website. It will be used with the Tiva™ C Series TM4C123G LaunchPad Evaluation Kit. Students will find the software useful when learning the ARM assembly language.

Academic Integrity:

All work submitted for CSE 379 must be your own and must be done on an individual basis. Cheating on projects, quizzes, or exams will result in automatic failure of the course.

Disabilities:

If you have a diagnosed disability (physical, learning, or psychological) that will make it difficult for you to carry out the course work as outlined, or that requires accommodations such as recruiting note-takers, readers, or extended time on exams or assignments, please advise the instructor during the first two weeks of the course so that we may review possible arrangements for reasonable accommodations. In addition, if you have not yet done so, contact the Office of Accessibility Resources.

Incompletes:

As per departmental and University policy, Incomplete (I) grades are only given in cases where the student has done satisfactory work, but only lacks one or two assignments/exams because of some sort of unexpected emergency or serious illness at the end of the semester. Do not request an "I" grade unless you believe that you actually fall into this category, and you are prepared to present evidence. Incompletes are given only in these very rare circumstances.

Professionalism:

- Students are expected to use professional style in all communications, including email, with course administrators. This includes the proper use of salutations/closing, grammar, and identification of oneself as the author of the correspondence.
- Students are expected to refrain from the use of cell phones or other electronic devices in class unless they are clearly linked to class purposes. Cell phones must remain off or muted during lecture and recitation (lab).