Microprocessor Systems – CPE 390

School of Engineering and Science

Spring 2018

Meeting Times:	Tuesday	3:00 – 4:40 pm	Burchard 118
	Thursday	1:00 –1:50 pm	Babbio 122
Instructor:	Prof. Bryan Ackland		
Contact Info:	Burchard 211, backland@stevens.edu, (201) 216-8096		
Office Hours:	Wednesday 9:30 am – 11:30 am		
	Thursday 10:00 am – 12:00 noon		
	Other times by appt. or just stop by my office		
Course Web:	http://personal.stevens.edu/~backland/Courses/Course390_Spring_18.htm		
Prerequisite(s):	E 115 - Introduction to Programming		
Corequisite(s):	None		
Cross-listed with:	CS 390		

COURSE DESCRIPTION

This course provides an introduction to microprocessor architecture, assembly language programming and the use of microcontrollers in implementing embedded systems. The internal architecture and operation of stored program microprocessors are examined in detail including arithmetic and logic units, special and general purpose registers, memory addressing modes and interrupts. Assembly programming techniques including data structures, branching, loops and subroutines are presented using simple design examples. Hardware and software techniques for I/O interfaces, both polled and interrupt driven are described. Specialized on-chip microcontroller interfaces for timing, serial communication and A/D conversion are used to implement simple I/O tasks useful in building real-time embedded systems. The course uses the Freescale HCS12 as an example of a 16-bit CISC architecture widely used in automotive applications. The course also compares this architecture to the ARM 32-bit RISC architecture.

In the laboratory component of the course, students will gain hands-on experience with assembly programming and interfacing of the HCS12 to external peripherals using a commercial evaluation board.

LEARNING OBJECTIVES

After successful completion of this course, students will be able to…

- Understand the architecture of a typical microprocessor as a stored program digital computer; you will understand the concepts of CPU, program counter, ALU, registers, memory, instruction set, machine code and assembly code.
- Write assembly language programs that exploit the various memory addressing schemes of the microprocessor to build and access simple data structures; you will be able to use arithmetic, logical, test and branching instructions to implement loops and perform simple computational tasks.

- Understand the concept of a stack and be able to write assembly language programs that use subroutines to create a hierarchical software structure that improves code readability and facilitates software re-use.
- Understand the concept of interrupts and be able to perform input/output tasks using both polling and interrupt based assembly code.
- Program a microcontroller and its on-chip peripherals such as timers, serial interfaces and A/D converters to create embedded systems that perform real-time sensing and control of external components.
- Understand the difference between CISC and RISC architecture and the relative advantages of each when applied to embedded systems based on an assembly and/or high level language implementation.
- Use commercially available software tools and microcontroller development boards to write, assemble, emulate, test, debug and implement embedded hardware/software systems.

FORMAT AND STRUCTURE

This course is comprised of two lectures (one 50 minute and one 100 minute) per week. There is also a laboratory component (150 minutes per week). All students who enroll in this course should also be enrolled in one of the associated lab sections (CPE 390 LA, LB or LC). In the lab, students work in groups of three. Lab grades are incorporated into the final grade of this course.

COURSE MATERIALS

Textbook(s): HCS12/9S12 An Introduction to Software and Hardware Interfacing, 2nd Edition, Han-Way Huang, Publisher: DelMar Cengage Learning, ISBN: 1-4354-2742-4, 2010.

Other Ref: (1) Microcontroller Theory and Applications, 2nd edition, D. Pack & S. Barrett, Pearson Prentice Hall, ISBN 0-13-615205-8, 2008.

(2) Computers as Components, W. Wolf, Elsevier, ISBN 0-12-369459-0, 2005.

Materials: None

COURSE REQUIREMENTS

Attendance Counts towards 5% of final grade. Each student is permitted (2) unexcused absences per semester without penalty.

Participation Up to (2) grade points bonus will be awarded to students who participate by frequently asking and answering questions in class

Homework There are usually eight (8) homework assignments throughout the course. All assignments count equally towards 20% of the final grade. All assignments should be submitted on the due date during class to the professor via hard copy. Homework assignments will be graded and returned within two class periods.

Labs Lab grades determined taking into account attendance, quality of participation and quality of report.

Exams There will be two exams in this course; a midterm and a final. The final exam is cumulative. The midterm will be taken in class according to the published class schedule. The final exam will normally take place during exam week; the time and place will be determined by the Registrar.

GRADING PROCEDURES

Grades will be based on:

Attendance	(5 %)
Homework	(20 %)
Lab	(25 %)
Midterm	(20 %)
Final	(30 %)

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"*I pledge my honor that I have abided by the Stevens Honor System*."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

EXAM ROOM CONDITIONS

The following procedures apply to exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the exam.

1. Students may use the following devices during exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	**Permitted?**	
	Yes	No
Laptops		X
Cell Phones		X
Tablets		X
Smart Watches		X
Google Glass		X
Stand-alone calculator	X	

2. Students may use the following materials during exams. Any materials that are not mentioned in the list below are not permitted.

Material	**Permitted?**	
	Yes	No

Handwritten Notes	X	
Typed Notes	X	
Textbooks	X	
Other reference books	X	

3. Students are not allowed to work with or talk to other students during exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. Student Counseling and Disability Services works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, and psychiatric disorders in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from SCDS staff. The SCDS staff will facilitate the provision of accommodations on a case-by-case basis. These academic accommodations are provided at no cost to the student.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the office of Student Counseling, Psychological & Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/sit/counseling/disability-services. If you have any questions please contact:

Lauren Poleyeff, Psy.M., LCSW - Disability Services Coordinator and Staff Clinician in Student Counseling and Disability Services at Stevens Institute of Technology at lpoleyef@stevens.edu or by phone (201) 216-8728.

INCLUSIVITY STATEMENT

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in education and innovation. Our community represents a rich variety of backgrounds, experiences, demographics and perspectives and Stevens is committed to fostering a learning environment where every individual is respected and engaged. To facilitate a dynamic and inclusive educational experience, we ask all members of the community to:

- be open to the perspectives of others
- appreciate the uniqueness their colleagues
- take advantage of the opportunity to learn from each other
- exchange experiences, values and beliefs
- communicate in a respectful manner
- be aware of individuals who are marginalized and involve them
- keep confidential discussions private

TYPICAL COURSE SCHEDULE
(Go to course website for exact schedule and homework due dates)

Week	Topic(s)	Notes	Homeworks
1	Class organization Introduction to Microprocessors	Lecture 0 Lecture 1	
	Digital Logic Basics	Lecture 2	
2	Elements of a Microcomputer System	Lecture 3	
	Introduction to the HCS12	Lecture 4	HW1
3			
	Assembly Language Programming (I)	Lecture 5	
4			HW2
	Assembly Language Programming (II)	Lecture 6	
5			HW3
	Data Structures	Lecture 7	
6	Subroutines	Lecture 8	HW4
7	Midterm Review		
8	Midterm Exam		
	Midterm Solutions		
9	I/O and Interrupts	Lecture 9	
			HW5
10	Parallel Ports	Lecture 10	
			HW6
11	Timer Functions	Lecture 11	

			HW7
12	Serial Interfaces	Lecture 12	
			HW8
13	Analog to Digital Conversion	Lecture 13	
			HW9
14	ARM - A RISC Microprocessor	Lecture 14	
	Final Review		
15	Final Exam		