ME 4447 / ME 6405
MICROPROCESSOR CONTROL OF MANUFACTURING SYSTEMS / INTRODUCTION TO MECHATRONICS

Instructor: Professor I. Charles Ume
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Office: MARC Building, Room 453
Office Hours: Wednesday 4:00 pm to 5:00 pm, or by appointment
Class Meets: TR 1:35 pm to 2:55 pm
Class Location: IC 117
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Course Lectures address the fundamental aspects of manufacturing elements and microprocessors and their applications. Hands-on applications of machine and machine tool control will be stressed.
ME 6405
INTRODUCTION TO MECHATRONICS

Modeling the performance characteristics and application of microprocessors, analog and digital electronics to modern mechatronics systems and intelligent manufacturing – particularly smart sensors, controllers and actuators.
Web Pages:
- Course: http://www.me.gatech.edu/mechatronics_course
- Lab: http://www.me.gatech.edu/mechatronics_lab

Prerequisite:
- ME 3015, System Dynamics and Control or Equivalent

Text:
1. *Mechatronics, by Sabri Cetinkunt, published by Wiley*
2. *Basic Microprocessors and the 6800, by Ron Bishop*
3. CPU12RG Reference Guide
4. MC9S12C Family Reference Manual
5. MC9S12C32 Device User Guide
7. Every group of 3 students is required to purchase an Axiom CML-12C32 and bread board.
Reference Text

3. Design with Microprocessors for Mechanical Engineers by Stiffler
4. 6801, 68701, and Microcomputer Programming and Interface, by Andrew C. Stauggard
5. Design with Microcontrollers, by John B. Peatman
6. Understanding Electro-Mechanical Engineering, an Introduction to Mechatronics, by L. J. Kamm
7. Mechatronics: Mechanical System Interfacing, by D. M. Auslander
# Syllabus:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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</table>
| 6    | Basic Instrumentation  
16-Bit microcontroller: introduction, hardware overview, programming, interrupts, on-chip subsystems, parallel I/O |
| 1.5  | PIC Microcontroller and C Programming |
| 2    | Choice of embedded computers (HCS12 (16-bit) and PIC (8- and 16-bit); choice of level of languages: low level (assembly), mid level (C) and high level (machine and ladder logic). |
| 2    | Analog and digital devices: Op-amp, ADC, DAC, and power transistors |
|      | Sensors and Transducers, Sensor Fusion *(now covered in ME 8843)* |
| 1    | Programmable Logic Controller |
| 0.5  | Manufacturing and Mechatronic systems |
|      | Motion Control, Actuators, and Mechanical Drives *(now covered in ME 8843)* |

Microprocessor Control of Manufacturing Systems, Georgia Tech
**Laboratory Exercises:**
There will be three electronics exercises and four labs during the semester. Electronics Exercises are done individually. Labs will be done in groups of three students.

- **Electronics Exercise #1**: Overview of Electronics Test Equipment, Soldering, and RC filters
- **Electronics Exercise #2**: 555 Timer and its Applications
- **Electronics Exercise #3**: Stepper Motor Controller & Driver
- **Lab #1**: Interfacing Communication with the HCS12 and sequencing Light Emitting Diodes
- **Lab #2**: Strain Gauge Data Acquisition Using A/D Conversion
- **Lab #3**: DC Motor Control Using Interrupts and Pulse Width Modulation (Open Loop Control)
- **Lab #4**: Programmable Logic Controller (PLC) Programming Assignment
**Grading:**

4 Quizzes 20%  Will be announced ahead of time
Test #1 20%  October 13
Lecture by Students (optional)* 20%
Test #2 20%  Next class after last student lecture.

* If you choose to participate in the class lecture, you can apply the best three of your four grades above towards your final grade, otherwise your quiz, Test #1 and Test #2 grades will be applied towards calculating your Final Grade.

Laboratory Exercises:
- Electronic Exercise #1: 2 %
- Electronic Exercise #2: 3 %
- Electronic Exercise #3: 3 %
- Lab #1: 6 %
- Lab #2: 10 % (Part A = 6%, Part B = 4%)
- Lab #3: 10%
- Lab #4 6 %

Laboratory Exercises Total: 40%
Notes:

1. This schedule is subject to change at the discretion of the instructor.

2. You are responsible for materials covered during your absence. **There are no make-up lectures or quizzes.** You will get zero for any quiz or test you missed, unless you made a prior arrangement with me and took it earlier.

3. Labs must be demonstrated to the TA, and lab reports submitted in the Lab the day they are due. **Late Labs will be penalized 25% for every day they are late.**

4. You must always clean up before you leave the Lab.

5. Reviews of a test grade quiz must be done within one week after the quiz or test is returned.

6. Regular attendance is required in this class.

7. No make-up projects or assignments will be given for grade enhancement.

8. Every student must take all the two class' tests and quizzes, even if he/she agrees to participate in the class lecture option.
**Laboratory Experience:**
You are required to complete the following:

1. Electronics Exercise 1: Overview of Electronics Test Equipment, Soldering, and RC Filters *(No Report)* (1 week)
2. Electronics Exercise 2: 555 Timer and its applications *(No Report)* (1 week)
3. Electronics Exercise 3: Stepper Motor Controller & Driver *(No Report)* (1 week)
4. Lab 1: Establish communication between the MC68HC11 and PC, and Sequencing light emitting diodes *(Report Required)* (2 weeks)
5. Lab 2: Strain gauge experiments *(Report Required)* (3 weeks)
6. Lab 3: DC Motor control experiment *(No Report)* (3 weeks)
7. Lab 4: Programmable Logic Control *(No Report)* (1 week)

**Lab Write-Up Procedure:**
1. Lab Objective (abstract)
2. Introduction
3. Experimental procedures or method (including drawings of the setup, circuitry and flow chart)
4. Discussion of the experimental results
5. Conclusion
6. References
7. Appendix
   - Program listings with good documentation
   - Specs for the components used in the circuitry
Lab Report Requirements:

1. Labs should be done exactly in accordance with procedures set out in the Course Outline, Lab Write-Up Procedure section.

2. Contents of the report should include answers to the questions proposed in the Understanding Objectives section of each Lab.

3. The report should by no means be strictly confined to the discussion of these questions.

4. The answers to the questions should be written in essay form and not delineated by question number; that is, the report should be a smooth and flowing document.

5. All lab demonstrations must be done in the Lab room on assigned days only.
Grading Forms
<table>
<thead>
<tr>
<th>Basis for Evaluation</th>
<th>Grade on A 10-Point Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge of the subject matter</td>
<td>_________________________</td>
</tr>
<tr>
<td>2. Effectiveness of the presentation</td>
<td>_________________________</td>
</tr>
<tr>
<td>3. Time Management</td>
<td>_________________________</td>
</tr>
<tr>
<td>4. Effort put in and depth of presentation</td>
<td>_________________________</td>
</tr>
<tr>
<td>5. Handouts and Transparencies</td>
<td>_________________________</td>
</tr>
<tr>
<td>6. I would like him/her to lecture again</td>
<td>_________________________</td>
</tr>
</tbody>
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**Average**  _______________________

**Note:** 9 to 10 points = A; 7 to 8 points = B; 5 to 6 points = C; 0 to 4 points = F

**COMMENTS:** _______________________________