ME 353

ME 353 Mechatronics

3 credits and 3 contact hours per week

Coordinator: Brian Cusack, Adjunct Professor of Mechanical Engineering.

Textbooks: (Recommended Reading)

- Mechatronics, Mechanical System Interfacing
  David Auslander and Carl Kempf - Prentice Hall 1996

- The C Programming Language (second edition)
  Brian Kernighan and Dennis Ritchie - Prentice Hall, Inc., 1988

- Introduction to Electrical Engineering (Second Edition)
  C.R. Paul, S.A. Nasar, L.E. Unnewehr - McGraw Hill 1992

- The Art of Electronics (Second Edition)
  Horowitz & Hill – Cambridge University Press 1998

Specific Course Information:

Catalog Description: Topics include computer architecture, PIC processor overview, dynamic modeling, sensors, data acquisition,digital PID control theory, and utilization of assembly language to code the controller. Students will design, build and test a controller board and present a final prototype of a control system. Engineeringeconomics will be introduced and integrated into the final project.

Prerequisite: ME 151 or ECE 121 or ChE 152

Goals:

1. Application of fundamental mechatronics topics
2. Reinforce problem-solving skills through system design and analysis
3. Develop professional attributes through the project design process

Prerequisites by Topic: Control Systems, Computer Programming

Specific Goals of Course:

i. Outcomes of instruction

- An understanding of Boolean logic
- An understanding of and basic proficiency in combination digital logic including solving Karnaugh maps for minimized logic equations while avoiding hazards
- An understanding of basic digital logic design.
- An ability to design and implement digital logic systems with descrete logic components
- An understanding of basic computer architecture, the use of machine code and assembly languages

- An understanding and proficiency of higher level languages ('C') to program microcontrollers
- An understanding of microcontroller funcationality in larger systems
- An understanding of analog to digital conversion and amplifiers/drivers

ii. Student outcomes (primary):

a) homework assignments are given for each of the main topics covered. These assignments are reviewed and returned with notes.

b) Students design and build small digital logic systems that must perform required tasks. These projects are presented in-class.

c/d/e/k) Students are divided into groups of 3-4 and design a small, autonomous sumo-robot which they compete against each other at the conclusion of the class. This semester long design project takes students through sketching, CAD, fabrication, assembly, electronics prototyping, sensor calibration, and microcontroller implementation.

f/g) groups must complete a technical paper documenting their design objectives and fabrication procedure. This paper includes all documentation required to replicate their design and includes: CAD drawings, circuit diagrams, MSDS sheets for fabricated materials, RoHS certification documentation for electronics utilized, circuit specification sheets and full source code for the microcontroller.

iii. Student outcomes (secondary):

g) Students are asked to communicate their ideas effectively through class participation, as well as through the short assignments their complete for the homework assignments. Students are expected to effectively communicate their fabrication requirements to machinists in order to receive the desired parts. Teams meet weekly with the instructor to summarize their progress and work through issues that arise. Team meetings require short progress reports and scheduled deliverables.

c/e/k) Students follow a predetermined project schedule, and are taken through a rigid work schedule step by step.

Brief List of Topics Covered:

- Boolean/Combinational Digital Logic
- Digital Logic Design
- Computer Architecture
- Programming 'C'
- Project Management
- Fabrication and prototyping
- Group meetings

Computer usage:

1. Programming using PIC assembly as well as C18 on PIC18F4520 microconrtollers utilizing MPLAB-IDE along with MPLAB-ICD3 programmers
    a. Analog to digital conversions are done on sensor data

    b. Algorythms are developed
    c. Control/driver signals are given to amplifiers
    d. Programming of a PID controller in 'C' is done in class
2. Word processing.
3. CAD tools are used for both design and direct manufacturing:
    a. 3D models are built in Solidworks in order to ensure proper placement and room for parts
    b. AutoCAD is frequently used for laser cutting of plastics

Assessment Methods:
Teams must present a working robot, one technical paper per team, class participation and graded indivdual homework assignments.

Additional Information

Grading policy – Grading of all assignments is not negotiable except in cases of factual error.

Missed deadline policy – Assignments may be handed in late without reason given within 24 hours but will be graded 20% off. No assignment will be accepted after 24 hours without documented medical or other emergent reason.

Policy on extra work – No extra credit projects will be assigned or accepted.

Policy on plagiarism – Every student must do their own work and any assignment, project or exam with the students name on it represents their statement that it is their original work. While students are encouraged to teach each-other, answer each-other's questions and act as available colleagues in consultation, each student's work must be their own. Any student caught cheating will be failed for the course and the incident will be reported to the dean's office.

Use of electronic devices – Use of personal electronic devices is allowed in class so long as they do not become a distraction to those around them. It is, however, recommended that notes be taken on paper, as has been shown to be more valuable a learning methodology than typing.

Disability accommodations - Students seeking accommodations due to a condition covered by the Americans with Disabilities Act are required to formally self-identify through the Office of Dean of Students. The Dean of Students will work with the students to clarify requested accommodations. It is the student's responsibility to speak directly to me to see how their accommodations can be met.

Medical absences - Students who have medical excuses for missing class should contact the Dean of Students promptly. Students will be required to provide the Dean of Students with documentation from a medical provider justifying the absence. The Dean of Students will

inform me when an absence is due to a valid medical issue/condition so that the absence can be considered excused. It is important to note that even with excused medical absences; a student is still responsible for completing all of the course requirements. If a student's absences have resulted in their missing vital components of in-class discussions and experiences, students may be required to withdraw from a course and retake it even with valid medical excuses. This is entirely at the discretion of the faculty member teaching the course. In addition to communicating with the Dean of Students, students must remain in regular communication with the faculty teaching the course when they need to miss a class.