SE 423 – Introduction to Mechatronics

3 Credit Hours

Lecture M W 11:00AM to 11:50AM, Room 3217 Everitt Laboratory
Lab AB1 Wednesday 3:00PM to 6:00PM Room 302 Transportation Building
Lab AB3 Thursday 9:00AM to 12:00PM Room 302 Transportation Building
Lab AB2 Thursday 3:00PM to 6:00PM Room 302 Transportation Building

Instructor: Dan Block
Email: d-block@illinois.edu
Office: 3005 ECE Building
Phone: 217-244-8573
Office hours: Monday and Wednesday 12-1PM, Tuesday 3-5PM and by appointment.


Additional Textbooks (Copies of these textbooks are kept in the lab.):
- http://www.engr.colostate.edu/~dga/mechatronics/

Course Description: SE423 is an elective course in Systems Engineering that focuses on the integration of embedded processors into mechanical systems. Students learn to program a number of different microcontroller and DSP processors to implement control and path planning algorithms for an autonomous robot car vehicle.

Prerequisite: SE 320 or equivalent Control Systems course, C programming experience is highly recommended.

Due Dates: Homework assignment due dates are listed below in the time schedule. No late submissions accepted for homework.
The Lab “check off” procedure will be explained thoroughly in your lab section. The due dates are posted at http://coecsl.ece.uiuc.edu/ge423/Lab Due Dates.htm

Quizzes: I do not intend to have lecture quizzes/tests but that could change depending on class attendance in lecture.

Semester Project: Working in a group of four students, students are asked to program a small robot vehicle to autonomously navigate an obstacle course while using the robot’s camera to locate colored objects on the floor. This requires the students to apply many of the topics taught in the homework and lab assignments in addition to adding their own creativity to solve the given task. There are specified “checkpoint” due dates to make sure the students are on the right track and do not wait until the last week to finish all the work.
Grading: All students are encouraged to attend every class period. The lecture content will follow the laboratory assignments in an obvious manner, so failure to attend a lecture will be a severe handicap in the lab. The semester project should represent the entire content of the class and is representative of a final exam grade.

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<tbody>
<tr>
<td>Check-off on all labs</td>
<td>30%</td>
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<tr>
<td>Homework</td>
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<td>Semester Project</td>
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Topics Covered:

- C programming of a MSP430 Microcontroller
  - Using Code Composer Studio
  - GPIO
  - PWM
  - ADC
  - UART serial interface
  - SPI serial interface

- C programming of Texas Instruments DSP processors
  - Using Real-Time Operating System SYS/BIOS
    - Timers
    - Hardware interrupts
    - SPI serial interface
    - Software interrupts
    - Threads
    - Semaphores
  - PI Speed Control design and implementation
  - Wall following / Obstacle avoidance using planer LIDAR distance sensor
  - Blob search vision algorithm for color tracking
  - Dead reckoning of robot pose using robot’s optical encoders and IMU sensor
  - Use of the Kalman filter to fuse dead reckoning pose with motion tracking pose

- C programming of Linux applications
  - Using shared memory to communicate between ARM processor running Linux and DSP processor core
  - Use of the Kalman filter to fuse
  - Implementation of the A* path planning algorithm