Carnegie Mellon University
Mechanical Engineering
Spring 2006

24.371 Electromechanical Systems

Instructor: **Dr. Levent Burak Kara**, lkara@andrew.cmu.edu
Hammerschlag Hall B-127, 268-8880
Office hours: Friday 4.00pm-5.00pm, HH B-127

Teaching Assistants: **Ozgur Unver**, ounver@andrew.cmu.edu
Scaife Hall 422, 268-5222
Office hours: Monday 4.30pm-6.00pm, SH 206 (starting 02.13.2006)

Joe Laws, nejiron@cmu.edu
973-222-9835
Office hours: Monday 4.30pm-6.00pm, SH 206 (starting 02.13.2006)

Tutors/Graders: **Bilsay Sumer** bsumer@andrew.cmu.edu
Scaife Hall 423, 268-8847
Michael Shum mcy@andrew.cmu.edu
Brian Sylcott bns@andrew.cmu.edu

Lectures: Tuesdays and Thursdays, 10:30am to 11:50am
Doherty Hall, DH 2315

Laboratories:

Section A: Tuesday	6:30pm – 8:30pm, HH B301
Section B: Wednesday	6:30pm – 8:30pm, HH B301
Section C: Thursday	6:30pm – 8:30pm, HH B301

There will be a total of three labs in this course.
Lab1. Basic Analog Circuit Analysis
Lab2. Digital Circuit Design
Lab3. Microcontroller Programming

The labs will be alternating with Prof. Burak Ozdoganlar's Dynamic Systems and Controls class. The exact dates of the labs will be announced by the end of January. *Do not go to lab until it is explicitly announced.*

Each lab assignment lasts for a few weeks and consists of three parts: (1) pre-lab reading assignment, (2) actual laboratory in HH B301, and (3) post-lab write-ups. Your lab grade will depend on your performance in all three parts.

Web Site and Contact:
We will be using Blackboard: http://www.cmu.edu/blackboard If you have a question, please go to **Blackboard > S06-ElectroMechanical Systems > Communications > Send Email > Select Groups**, and send an email to the group called "**Teaching Staff**". This way, more people will be available to answer your question.

Required Textbook:
Introduction to Mechatronics and Measurement Systems by David G. Alciatore & Michael B. Histand. Third Edition, ISBN # 0072963050
Laboratory Exercises by David G. Alciatore & Michael B. Histand, ISBN #0072978759

Technical Content:
Most mechanical devices need, or are enhanced by, an electrical or computer subsystem. This course is intended to teach Mechanical Engineering undergraduate students about these subsystems. The course starts with basic analog electrical components, analog circuit analysis techniques, logic and digital circuit design, transistor physics, operational amplifiers, sensors and actuators, and microcontroller programming. Using these electrical and computer tools, students will learn to analyze sensory signals and control actuators as a way to construct integrated electromechanical systems. Three laboratory assignments include design, construction, and analysis of analog and digital circuits, and programming a microcontroller to control a motor.

- This course is a required course in Mechanical Engineering.
- This course covers electrical engineering materials for mechanical engineers.
- This course does not require 18-100 as a pre-requisite.
- By the end of the course, you will be able to
    - o Design and analyze simple analog circuits
    - o Design and analyze simple digital circuits
    - o Use transistors and OpAmps in your circuit design
    - o Program and use a microcontroller to control motors
    - o Understand how sensors and actuators work

Homework:
Homework will be assigned weekly. They will be due at beginning of class on **Tuesdays**. No credit will be given for assignments submitted after the lecture starts (without a 24-hour advance permission from the instructor). Homework should be placed in the box set out for that purpose just inside the entrance to the lecture hall. Homework will be picked up immediately, and late submissions will be penalized and may not be graded. Solution sets will be posted later in the day on which the homework set is due.

Discussion of homework assignments is encouraged but each student must submit an individual solution. However, students should not merely copy a classmate's assignments. By the time an assignment is handed in, you should be able to explain what you are handing in, and, at a short time later, should be able to independently reproduce what you have done. Students who, upon request, are unable to explain the assignments they hand in may be penalized.

All written submissions must be neat and legible; points may be deducted when the grader has difficulty grading your work.

Quizzes:
There will be two quizzes and one final exam. You must bring a calculator. Violations of the university's rules of conduct will not be tolerated. Quizzes will be held on the following days:

Quiz 1	February	23, 2006
Quiz 2	March	28, 2006
Final Quiz	May	04, 2006 (last day of our class)

Grading Policy:
The instructor reserves some latitude in assigning grades, using a variety of input. The following approach will be used to determine grades:

Quiz 1	15%
Quiz 2	15%
Final Quiz	20%
Homework	25%
Lab 1	8%
Lab 2	8%
Lab 3	9%
Total	100%

The following should be taken as the rough break down for grades.

A: $85 \leq$ Total
B: $75 \leq$ Total < 85
C: $65 \leq$ Total < 75
D: $60 \leq$ Total < 65
R: Total < 60

At his discretion, the instructor may use additional factors, such as knowledge of students' efforts and attendance in class, to adjust grades.

Carnegie Mellon University, Mechanical Engineering, Spring 2006
Instructor: Levent Burak Kara
24.371 Electromechanical Systems

Tentative Class Syllabus

Week	Date	Topics and Assignments	Week	Date	Topics and Assignments
1	1/17	Introduction to EMS Resistor, Capacitor, Inductor (Chapter 2 (Chapter 1,2)	9	3/14	**Spring Break, No class**
	1/19	Circuit Elements (Chapter 2) Kirchhoff's laws (Chapter 2) Parallel and series resistors (Chapter 2)		3/16	**Spring Break, No class**
2	1/24	Alternating Current (Chapter 2) Complex Impedance (Chapter 2)	10	3/21	MICROCONTROLLER (Chapter 7)
	1/26	Summary of Impedance formulas (Chapetr2) Example by the TA's (Chapter 2)		3/23	OPAMPS: INVERTING AND NONINVERTING AMPLIFIERS (Chapter 5)
3	1/31	Electrical Power (Chapter 2)	11	3/28	OPAMPS: INSTRUMENTATION AMPLIFIER (Chapter 5)
	2/2	Strain gage (Chapter 9) SENSOR: ACCELEROMETER (Chapter 9)		3/30	OPAMPS: COMPARATOR SENSORS: EMG (Chapter 5) **Midterm2**
4	2/7	DIGITAL CIRCUIT: LOGIC, BOOLEAN ALGEBRA (Chapter 6)	12	4/4	
	2/9	DIGITAL CIRCUIT: NETWORKS (Chapter 6)		4/6	HYDRAULICS, PNEUMATICS (Chapter 10)
5	2/14	DIGITAL CIRCUIT: FLIP-FLOPS (Chapter 6)	13	4/11	SYSTEM MODELING (Chapter 4)
	2/16	SEMICONDUCTOR PHYSICS, DIODES (Chapter 3)		4/13	SYSTEM MODELING (Chapter 4)
6	2/21	JUNCTION DIODE (Chapter 3)	14	4/18	DATA ACQUISITION (Chapter 8)
	2/23	**Midterm 1**		4/20	
7	2/28	BIPOLAR JUNCTION TRANSISTOR (Chapter 3)	15	4/25	MEASUREMENT FUNDAMENTALS, STATISTICS (Appendix A)
	3/2	FIELD EFFECT TRANSISTOR (Chapter 3)		4/27	CONTROL ARCHITECTURE (Chapter 11)
8	3/7	DC MOTORS (Chapter 10)	16	5/2	APPLICATION: MICRO/NANO SYSTEMS
	3/9	ENCODERS, PWM (Chapter 9, 10)		5/4	APPLICATION: ROBOT **Final Exam**