Course Syllabus
EE 410/510 Section 02 – Spring 2010
Electromechanical Systems
T/Th 12:45 – 2:05 PM  TH N155

Course Instructor:
Dr. J. D. Williams  406 Optics Building  (256) 824 – 2898  williams@ece.uah.edu

Office Hours:  2 -3 PM T/Th or any other time that I am in.
Final Exam:  Monday, May 3  11:30-2 PM

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Optional Reading:
1. H.D. Chai, Electromechanical Motion Devices, Prentice Hall, 1998

Course Description: Magnetic reluctance, torque, and linear motion analysis. Analysis of common power
electronic schemes required for electromagnetic motion devices. Modeling and simulation of
electrically driven magnetic motion systems and drive electronics using MATLAB and Simulink.
Equations of motion governing DC and AC motors. Performance characteristics of various DC and AC
Motor Designs simulated using MATLAB and Simulink. Introduction to PID control and simulation of DC
motors.

Course Prerequisites: Either of the following courses depending on which program you come from
MAE 364: Kinematics and Dynamics of Machines - Kinematics and dynamics of planar machinery.
Principles of mechanisms, design of cams, fundamentals of gears and epicyclic gear trains, methods of
determination of velocity and acceleration in mechanisms. Inertia forces in machines, balancing of
rotating masses and reciprocating masses, and vibration analysis. Prerequisite: MAE 110, 272.
EE 307: Electricity and Magnetism - Basic concepts of electrostatics, electric potential theory, electric
fields and currents, fields of moving charge, magnetic fields, time varying electromagnetic fields,
Maxwell’s equations. Prerequisite: EE 213, MA 238, 244.
**Course Material:** This course will attempt to cover a large portion of the material presented below. The instructor reserves the right to reduce the coverage as needed to best suit the needs of the students registered. Chapters listed as advanced topics may be shortened or eliminated from course discussions in order to conserve time and provide a detailed coverage of DC and elementary AC motor design.

*Chapter 1: Introduction to Electromechanical Systems*

*Chapter 2. Analysis of Electromechanical Systems*
- Review of Electromagnetics
- Review of Classical Mechanics
- Introduction to MATLAB and Simulink

*Chapter 3. Introduction to Power Electronics*

*Chapter 4. DC Electric Machines and Motor Devices*
- Geometry and Equations of Motion Governing DC Electric Motors
- Modeling and Simulation of DC Electric Motors
- Permanent Magnet DC Generator
- DC Electric Machines with Power Electronics
- Axial Topology of DC Electric Machines and Magnetization Currents

*Chapter 5. Induction Machines (some advanced topics)*
- Overview 2 Phase AC Induction Motors
- Equations of motion for 2 Phase AC Induction Motors
- Torque Characteristics
- 3 Phase induction motors
- Introduction to Quadrature and Direct Variables
- Arbitrary Reference Frames
- Simulation of 2 and 3 Phase AC Induction Motors using MATLAB and Simulink

*Chapter 6. Synchronous Machines (advanced topic)*
- Introduction
- Single and Three Phase Reluctance Motors
- Two and Three Phase Permanent Magnet Synchronous Motors and Stepper Motors
- MATLAB and Simulink Simulations

*Chapter 7. Introduction to Control of Electromechanical Systems and PID Control Laws*
- Equations of Motion Governing the Dynamics of Electromechanical Systems
- Analog PID Control laws and application involving Permanent Magnet DC Motor
- Digital PID Control Laws and application involving Servosystem with Permanent Magnet DC Motor

**Homework:**
Homework will be assigned throughout the semester and is due 7 days after assignment. Assignments will be graded and returned to account for 30% of the final course grade.

**Exams:**
Two in class exams will be given during the semester. Students will be allowed the use of a calculator during the exam. All work will be performed independently. Each exam will account for 25% of the student’s grade. The final exam will be comprehensive covering major topics presented throughout the semester and will constitute 20% of the course grade.

**Final Grade:**

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<tbody>
<tr>
<td>Homework</td>
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<td>Exams</td>
<td>2 per Semester</td>
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<td>Final</td>
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