Department of Engineering

MENG 4350 Electromechanical Systems Design

Catalog Description
4350 Electromechanical Systems Design (3). (S) 2 lecture hours and two lab hours. C: ENGR 3050. Application of motion sensors and actuators; real-time closed-loop control of electromechanical/robotic systems; motor control and digital controller design methods.

Required Text
Cetinkunt, Sabri. *Mechatronics*. John Wiley & Sons, 2006, ISBN-13: 9780471479871

Course Objectives: Upon completion of this course, students will be able to:

- Describe components and applications of electro mechanical systems
- Characterize motion sensors and actuators
- Understand principles of rotary machines (motors and generators) and related controls
- Model electro mechanical systems
- Evaluate performance of electro mechanical systems
- Interface electrical control device with mechanical/pneumatic systems
- Design digital control systems for mechanical systems
- Describe components and applications of robotics

Topical coverage

Introduction to Electro mechanical systems:
- Overview of electro mechanical systems
- Sample electro mechanical systems: Hard-disk drives (HDD)

Sensors:
- Position measurement
- Accelerometers
- Temperature sensors.
- Strain, stress, force measurement

Actuators:
- DC Motors
- Stepper motors
- Hydraulic motors
- Piezo actuators

Interfacing:
- Op amps,
- Signal conditioning,
- AD/DA,
- Power Amplifiers
- MATLAB serial communication

Digital Controller Design:
- Sampling process,
- Linear discrete time models,
- z-transform,
- Discrete transfer function,

- Approximate continuous design
- PID control and relay automatic tuning.
- Repetitive control

Robotics

- Robotics overview
- Path planning
- Robotics vision and intelligence
- Human-machine interface
- Applications of robots

Misc.

- Motor controllers
- PLC and Industrial Automation
- LabVIEW virtual instrumentation/MATLAB Instrument Toolbox/Data Acquisition Toolbox
- Mechatronics – towards the successful design.

Laboratory Experience:

Lab Topics:

1. Motion Sensor (interfacing, calibration, frequency domain characterization) with LabVIEW
2. Actuator
3. PLC programming
4. Modeling of DC Motor System
5. System Identification of an AC induction motor system
6. System Identification of a DC Motor system
7. DC Motor position, set point control via PID controller using relay automatic tuning technique
8. Three phase power and induction motor control systems

Design Projects:

1. Independent modeling, analysis, and design of an electro mechanical control system

Grading Policy and Assignments

Students will be evaluated based on the combination of class activities. The final grade will be assessed with the following criteria:

Grading			**Assessment**	
A	90% or better		Homework/Assignments	10%
B	80% or better		Design Project	15%
C	70% or better		Laboratory Projects	20%
D	60% or better		Tests	30%
F	Less than 60%		Final Exam	25%
			Total	100%