University of Arkansas - Fort Smith
5210 Grand Avenue
P. O. Box 3649
Fort Smith, AR 72913-3649
479-788-7000

General Syllabus

EETE 33003 Motion Control System Design

Credit Hours: 3 Lecture Hours: 1 Lab Hours: 4

Prerequisites: Junior standing or consent of department head.

Effective Catalog: 2018-2019

I. Course Information

A. Catalog Description

Covers the design and optimal selection of electrical/mechanical power transmission components for servo motion control systems. Students will learn how to calculate torque/speed/inertia required of the motor which is used to select the proper size servo or vector motor and matching motor control.

B. Additional Information

This course is an upper division, technical elective for Bachelor of Applied Science degree students and Organizational Leadership students with the required prerequisites. It may also be taken by working engineers/technicians to upgrade their motion control design skills, if they meet the required prerequisites.

II. Student Learning Outcomes

A. Subject Matter

Upon successful completion of this course, the student will be able to:

1. Calculate the mass or weight inertia of typical machine mechanisms and attached loads.
2. Determine how gearbox, pulley, lead screw and rack/pinion mechanisms affect the inertia, torque, speed and horsepower/kilowatts required to start/stop/move a load in a given time.
3. Calculate the effects of friction for horizontal/vertical motion mechanisms and typical power-train design trade-offs of compliance, backlash and inertia matching capabilities.
4. Select motor & control to match the system inertia and meet the system requirements for motor peak/continuous torque and speed, minimum

control bus volts/amps, and maximum motor winding temperature for a given duty cycle and ambient temperature.
5. Select optimum servo motor winding torque/speed constants or BEMF, by adjusting gear/pulley ratios, selection of different AC line voltage or amp rating of motor control.
6. Select, assemble and test servo system components for typical industrial automated systems motion applications such as synchronized motion, cut-to-length or x-y table control.

B. University Learning Outcomes
This course enhances student abilities in the following areas:

Analytical Skills
Quantitative Reasoning – Students will apply mathematical techniques to find optimal solutions to problems drawn from a variety of typical automated motion control systems. Students will apply mathematical information to scale and calculate mechanism inertia, friction, and motor motion profiles and use quantitative reasoning to solve problems. Student will interpret the mathematical volume/density/inertia formulas, calculate required motor torque/speed for typical machinery distance/velocity/ acceleration/deceleration motion profiles.

III. Major Course Topics

A. Calculation of mass or weight inertia of typical machine mechanisms and attached loads.
B. Gearbox, pulley, lead screw and rack/pinion mechanisms effect on inertia, torque, speed and horsepower/kilowatts required for a given load, duty cycle and efficiency.
C. Frictional effects for horizontal/vertical motion mechanisms and typical power-train design trade-offs of compliance, backlash and inertia matching.
D. Servo/vector motor & control selection to match the system inertia and meet the system requirements for: motor peak/continuous torque and speed, minimum control bus volts/amps, and maximum motor winding temperature for a given duty cycle and ambient temperature.
E. Selection of optimum servo motor winding torque/speed constants or BEMF, by adjusting gear/pulley ratios, selection of different AC line voltage or amp rating of motor control.
F. Application case studies exercises: Using Baldor sizing software, select, assemble and test servo system components for typical industrial automated systems motion applications such as synchronized motion, cut-to-length or x-y table control.