ENG ME 560 Precision Machine Design and Instrumentation

Credits: 4. Engineering topic

Number of Contact Hours: 4 lecture hours per week

Instructor or Coordinator: Prof. Andre Sharon

Textbook(s) and/or Other Required Material:
Text: Machine Design and Control – A Systems Level Approach, Andre Sharon 2014

Catalog Data:

This course melds traditional machine component design with the design, instrumentation, and control of high precision, computer-controlled automation systems, using concrete examples drawn from the photonics, biotech, and semi-conductor industries. Topics covered include design strategy, high-precision mechanical components, sensors and measurement, servo control, design for controllability, control software development, controller hardware, as well as automated error detection and recovery. Students will work in teams, both in classroom and out-of-classroom, to integrate and apply the material covered in class to a term-long multi-part design project, using modern CAD tools, culminating in a group presentation at the end of the semester.

Prerequisites by topic:
Dynamics; Mechanics of Materials

Co-requisites by topic:
None

Status in the Curriculum: Elective

Goals:
1. Equip engineering students with the knowledge and experience to design instrumented, computer-controlled machinery.
2. Teach students how to financially justify and successfully execute a machine development project.
3. Give students interdisciplinary hands-on experience in the design of electro-mechanical systems.

Course Learning Outcomes:
As an outcome of completing this course, students will:

i) Have the tools necessary to design and instrument computer-controlled machinery (1, 2, 3, 5, 7)
ii) Understand basic actuator technologies (1, 2, 7)
iii) Understand basic sensing technologies (1, 2, 7)

iv) Understand basic machine control strategies (1, 2, 7)
v) Understand basic transmission elements (1, 2, 7)
vi) Be able to size and select proper actuators, sensors, and controller hardware (1, 2, 3, 5, 7)
vii) Have the knowledge to financially justify, plan, and execute a machine development project (1, 2, 3, 4, 5, 7)

Course Learning Outcomes mapped to Student Outcomes:

Student:	1	2	3	4	5	6	7
Course:	i-vii	i-vii	i, vii	i, vii	i, vi, vii	-	i-vii
Emphasis:	5	5	4	3	5	1	5

Topics (time spent in weeks):

1. Examples of real industrial machine design projects — 1.0 wks
2. Machine Design and Instrumentation Strategies — 1.0 wks
3. Financial Justification and Project Planning — 1.0 wks
4. Actuators — 1.5 wks
5. Transmission Elements — 1.5 wks
6. Joints and Bearings — 1.0 wks
7. Sensors — 1.5 wks
8. Servo Control and Design for Controllability — 1.5 wks
9. Computer Control Software and Hardware — 1.5 wks
10. Vision and Image Processing — 0.5 wks
11. User Interface, Error Detection and Recovery — 0.5 wks
12. Term Project Presentations — 3.0 wks

Status of Continuous Improvement Review of this Course:
Date Last Reviewed: **Reviewed by**:

Prepared by: Andre Sharon   **Date**: 9/12/2022