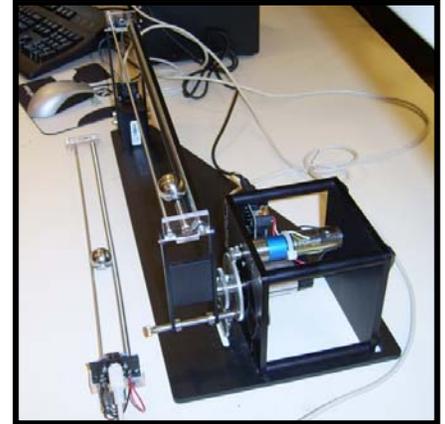


ES360 Control Systems Laboratory

Summary: ES360 is a required introductory automated control systems course for non-engineering students. The course is an introduction to the fundamentals and design of automated control systems. It provides future naval officers with a foundation upon which to build specific systems knowledge of control systems in use on Navy ships, aircraft, and weapons. It emphasizes analysis of control systems, identification of components, and develops conceptual understanding and intuition through a series of hands-on laboratory experiences. The course balances simulation through MATLAB examples with hands-on experiments to illustrate course topics.



Credits: 0-2-1

Prereq: Calculus II, Chemistry II, and Physics II.

Topics/Text: *There is no required textbook.*

- Graphical and computer techniques for qualitatively understanding systems
- Systems design methods: Modeling and simulation, Experimentation
- Time Response of systems, response measurement parameters
- Design for response and stability
- Feedback
- Automated control system components, functional block diagram
- Controller operation, PID controllers and tuning
- Ethics of military autonomous vehicles



Laboratory Hardware: We use three lab devices.

- *Ball and Beam* – quintessential control system, maintains steel ball at desired position using MATLAB and SIMULINK controller implementing a PID controller.
- *Motorized cart* - Small, speed-controlled 4-wheel car operable in either closed or open loop modes. Data acquisition available via wireless telemetry.
- *Inverted pendulum and Segway*- examples of inherently unstable systems.

Sample Lab Exercises

- Experimental design of a system to achieve design parameters: motorized carts
- Simulation of transient response of mechanical system: F-18 main landing gear oleo-pneumatic strut