United States Naval Academy
Department of Weapons, Robotics, and Control Engineering

Course: SY202 Cyber Systems Engineering

Credits: 3 credits – 2 recitation hours – 2 laboratory hours

Course Description: An introductory practicum that emphasizes interconnected cyber-physical systems, communications between those systems, the controls and the associated space in which these relationships exist. The course provides students with an enhanced understanding of basic tools and techniques of cyber systems engineering and the vulnerabilities of such systems. Each student will be required to comprehend fundamental cyber physical and communications systems.

Pre-requisites: SY201, SM223, SP211

Course Coordinator: Assoc. Prof. Rodriguez-Seda

Textbook: None

Course Objectives: At the completion of the course, the student will be able to:

- Understand tools and techniques used in the design and analysis of cyber-controlled engineering systems
- Identify and discuss advantages and disadvantages—including cyber vulnerabilities—related to cyber-physical systems
- Understand and differentiate the notion of open and closed-loop control
- Apply linear modelling techniques to model simple control systems and predict system response
- Synthesize a simple control system using a microcontroller, actuators, and sensors
- Understand and synthesize analog, digital, and serial peripherals as part of a simple embedded system
- Design, implement, and evaluate a linear control system in a microcontroller to regulate a physical system, while meeting some specific performance criteria
- Understand the topology, actions, and cyber vulnerabilities—as well as the impact of malicious attacks—within a supervisory control and data acquisition (SCADA) system
- Basic knowledge on the use of wireless communication and how to affect a cyber-physical system
- Have a basic knowledge of and familiarity with:
    - MATLAB dynamic simulation capabilities, including SIMULINK
    - C programming language
    - Microcontroller hardware, firmware, and software
    - Serial communication
    - Power supplies
    - Analog, digital, and serial sensors

Topics:

- Introduction to Cyber-Physical Systems and Mechatronics
- Functional Block Diagrams
- Modeling and Transfer Functions
- Time System Response
- PID Controllers
- Actuators and Sensors
- Embedded Systems
- C++ and MATLAB Programming
- Serial Communications

- Real-Time Control
- Industrial Control Systems and Networked Control Systems
- Cyber Attacks
- Resilient Control

Last Updated: 28-December-2020