

# ECE 5555: Securing Autonomous Systems

## Course Description

The course covers different security measures for safeguarding against cyberattacks, detecting cyberattacks, and mitigating the effects of cyberattacks on autonomous control systems.

**Transcript Abbreviation:** Secured Autonomy

**Grading Plan:** Letter Grade

**Course Deliveries:** Classroom, 100% at a distance

**Course Levels:** Undergrad, Graduate

**Student Ranks:** Senior, Masters, Doctoral, Professional

**Course Offerings:** Autumn, Spring, Summer

**Flex Scheduled Course:** Never

**Course Frequency:** Every Year

**Course Length:** 14 Week

**Credits:** 3.0

**Repeatable:** No

**Time Distribution:** 3.0 hr Lec

**Expected out-of-class hours per week:** 6.0

**Graded Component:** Lecture

**Credit by Examination:** No

**Admission Condition:** No

**Off Campus:** Never

**Campus Locations:** Columbus

**Prerequisites and Co-requisites:** Prerequisite: ECE 3050, or Graduate standing in Engineering, Math or Statistics

**Exclusions:**

**Cross-Listings:**

**Course Rationale:** The course will be part of Cyber Security Graduate Certificate and also an elective course for ECE students pursuing an MS degree.

**The course is required for this unit's degrees, majors, and/or minors:** Yes

**The course is a GEC:** No

**The course is an elective (for this or other units) or is a service course for other units:** Yes

**Subject/CIP Code:** 14.1001

**Subsidy Level:** Doctoral Course

## Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

## Course Goals

Apply knowledge gained in mathematics, physical sciences and engineering courses to derive mathematical models of typical engineering systems to be controlled
Provide introductory concepts in feedback control systems
Introduction to various cyberattacks launched on autonomous control systems

Apply knowledge gained in mathematics, statistics, physical sciences, and engineering courses to derive algorithms that defend against cyberattacks in autonomous control systems

Implement secure control algorithms on Arduino, Raspberry Pi, or microcontrollers

## Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to closed loop control systems, state space model in discrete time, and hierarchical control systems	7.0							
Control architecture and challenges in complex autonomous systems	3.0							
Review of statistical concepts, mean, covariance, law of large numbers, classification and regression	7.0							
Review of vulnerabilities in control systems; passive, active, and proactive measures for security	4.0							
Attack detection, signature based anomaly detection, change detection, dynamic watermarking, digital twin technology	10.0							
Attack mitigation through active interventions	9.0							

## Grades

Aspect	Percent
Homeworks	40%
Project	40%
Midterm	20%

## ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
**	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
*	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
**	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
**	i	A recognition of the need for, and an ability to engage in life-long learning.
*	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Course Contribution		Program Outcome
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

### EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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