Cyber-Physical Systems Syllabus

VXY/OXY, Variable Credits

Thursday, 3:30pm-4:20pm, Klaus 1440

Instructor Information

Instructor	Email	Drop-in Hours & Location
Lee Lerner	Lee.Lerner@gtri.gatech.edu	

Co-Instructor(s)	Email	Drop-in Hours & Location
William Stuckey	William.Stuckey@gtri.gatech.edu	By request
Samuel Litchfield	Samuel.Litchfield@gtri.gatech.edu	Klaus 1440 Monday 3:30pm-4:20pm
Hayden Cook	Hayden.Cook@gtri.gatech.edu	

General Course Information

Description

Cyber-physical systems (CPSs) integrate computational components with physical processes, e.g., robotics, automobiles, factories. Students in this course will learn CPS concepts such as design fundamentals through hands-on development and verification, as well as red-teaming for vulnerability discovery and mitigation. Students will address issues involving design complexity, security, and safety of these systems through the application of novel embedded development techniques, languages, and formal methods. Students will learn with ground-based robots and industrial control systems.

Pre- &/or Co-Requisites

There are no pre-requisites or co-requisites for this course.

Course Goals and Learning Outcomes

By the end of this course sequence, students will be able to:

1. Embedded Systems Hardware and Software Development: Participate in active development of complex hardware and software co-development with respect to cyber-physical systems
2. Hardware/software reverse engineering and vulnerability assessment: Students will be exposed to reverse engineering concepts, and participate in hardware/software RE as supported by available firmware images
3. Dynamical Systems and Controls: Students will analyze dynamical systems and develop control schemes as the developed cyber-physical system interacts with its surrounding environment
4. Network protocol capture/dissection: Students will work with relevant network protocols used by fielded CPS, including DNP3 and Modbus
5. Cybersecurity: Students will analyze cybersecurity issues, and propose potential mitigations, for modeled devices used in electrical substations.

Course Requirements & Grading

VIP teams function like real-world project teams. Members work on different aspects of a shared project, ranging from sophomores to graduate students, and from first-time participants to those with multiple semesters of experience. Students may enroll for variable credit hours, which are considered in grading. **Note:** Zero-credit enrollment is reserved for paid participants and follows the same grading criteria.

This class is specifically framed to mirror the sponsored research environment, with three class-wide presentations for project kickoff, interim project review, and final project review. Each of these presentations are given to the entire class on the dates noted in the schedule. All other class meetings are

working research meetings, where sub teams will meet with the team instructor and give weekly updates on their progress, bring forward any problems encountered which the instructor and team will work on solving during the rest of the class session. Students are expected to come to these working research meetings prepared to discuss their progress or any outstanding issues they encountered.

Grading Overview

Each student is evaluated across three core areas, with three mandatory requirements. Regardless of role or experience, students must demonstrate achievement in all three areas:

1. **Documentation and Records (33%)**
   - VIP Notebook in personal Github Wiki Page (required).
   - Contribute to team documentation via Github Wiki
2. **Personal Contributions (33%)**
   - Midterm and Final paper;
   - Engagement in project;
   - Pursuit of knowledge necessary for project;
   - Contributions to the technical progress of the team, measured via observation and Github code contributions;
   - Experienced members of the team are expected to contribute to the management of their sub-team.
3. **Teamwork and Interaction (33%)**
   - Participate in peer evaluations.
   - Attend meetings on time.
   - Collaborate toward team goals.
   - Coordinate and assist teammates.
   - Contribute to team presentations.

Rubric

Rubrics for Notebooks and Presentations are available on Canvas.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Course Materials

Materials/Resources

No materials or equipment are required prior to attendance. Computing resources will be provided to participate in group development activities.

Course Website and Other Classroom Management Tools

This course uses Canvas for distribution of class materials, rubrics, and announcements, and a course Github group for hosting course code repositories, personal notebooks, and broader class documentation. Peer-to-peer coordination can be done either through group chosen communication platforms or via a class-specific Discord.

Peer evaluations are administered by the VIP Program Click Here to access peer-evaluations from off campus. Click here to access from on campus. You will be prompted to sign in. Users can only log in from

on campus or via VPN. Students can only access the peer evaluation portion of the system during active evaluation periods.

Course Policies, Expectations, & Guidelines

VIP is a collaborative, multidisciplinary, project-based learning and research experience. Your success in this course depends not only on your technical contributions but also on your active engagement with your team and the broader learning process.

Your Role in the Learning Process

As a VIP student, you are expected to:

- Take initiative in exploring and applying knowledge relevant to your project.
- Collaborate effectively with team members across disciplines and experience levels.
- Document your work thoroughly.
- Reflect on your learning and contributions throughout the semester.

This course is a real-world team environment, where learning is dynamic, self-directed, and collaborative. Your growth depends on your willingness to engage, contribute, and learn from others.

Team Meetings and Participation

Attendance and active participation in **team meetings** and **sub-team meetings** are required. These meetings are essential for:

- Coordinating project tasks and timelines.
- Sharing progress and receiving feedback.
- Learning from peers and mentors.
- Contributing to team decisions and direction.

Failure to attend meetings without valid reason may negatively impact your grade and your team's progress. If you anticipate missing a meeting, communicate with your team and advisor in advance.

Use of External Resources

You are encouraged to consult external sources to support your learning and project work. However:

- Do **not present someone else's work as your own**.
- Always **cite and reference** external materials used in your notebook, code, presentations, or other deliverables.
- Proper attribution is essential to maintain transparency and integrity in a collaborative research environment.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Attendance and/or Participation

No attendance is taken during class, but we expect all students to actively participate, and expect that individual notebook entries will reflect discussions in which each student participates. Additionally, all students are expected to actively participate in group-wide presentations at Kickoff, Midterm Progress Reports, and Final Presentations. If students have conflicts with these presentation sessions, students are expected to record audio of them presenting their developed sections to show active participation.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

If you expect to be late or require an extension, please reach out to instructors via email. We are generally understanding and liberal, but will evaluate requests on a case-by-case basis

Inclement Weather and Digital Learning Days

In the case of inclement weather events, instructors will post an announcement to the class Canvas page on either rescheduling specific activities or hosting class discussions remotely via Discord.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of us and that we have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we encourage you to remain committed to the ideals of Georgia Tech while in this class.

Student Use of Mobile Devices in the Classroom

Use of mobile devices is not prohibited during group meetings, but students are expected to be participating and to not be disruptive. During group presentations, students are expected to be either actively presenting or actively listening, and disruptive mobile device usage will be addressed individually.

Additional Course Policies

VIP Room and Equipment Use Policy

VIP rooms and equipment are shared resources used by multiple teams. To ensure a productive and respectful working environment, the following rules apply:

1. Room Usage Priorities

Room use is prioritized as follows:

1. Scheduled team meetings, lectures, and learning modules
2. Weekly sub-team meetings (multiple groups may share the space)
3. Video conferences or special meetings with VIP stakeholders
4. Other project-related work (multiple groups may share the space)

Room schedules are available on the VIP website.
Note: A "good neighbor" policy applies—students may use rooms during other activities as long as they do not cause disruption. Quiet individual work or studying is allowed when it does not interfere with scheduled uses. Similarly, multiple groups may use a VIP room at the same time.

2. Cleanliness and Conduct

- Everyone is responsible for keeping rooms clean.
- Food is allowed, but spills must be cleaned immediately.
- **Gum must be disposed of properly—do not stick it under desks or on carpets.**
- Rooms are monitored by cameras; violations may be reviewed via video.

3. **Equipment Use**

- Equipment may be designated for general use or assigned to specific teams.
    - General use examples: Projector in Klaus 1440, monitors in VL 465 and VL 463B.
    - Equipment assignments may change each semester.
- If unsure about equipment access, contact: vip-request@ece.gatech.edu

- Use equipment only for its intended purpose. Misuse may pose safety risks.

Important Equipment Rules:

- Equipment may not be removed from VIP rooms without a signed loan agreement approved by a VIP Director.
- You are financially responsible for any equipment not returned in good condition.
- You must know how to operate equipment safely. Approval to use equipment does not imply safety training has been provided.

4. Computer Accounts

- Accounts are for individual use only—do not share with others.
- All usage must comply with Georgia Tech, USG Board of Regents, and State of Georgia policies.
- Respect privacy and data integrity. Having access to a file does not mean you are authorized to read or modify it.

5. BuzzCard Access

- Access is a privilege and is logged.
- Rooms are under video surveillance. In cases of theft, vandalism, or messes, logs and footage will be reviewed.
- Do not allow unauthorized individuals into VIP spaces.
- Always secure the room (close the door) when leaving.

Campus Resources for Students

Undergraduate Student Academic Success Resources:
A list of resources for undergraduate students' academic success and information about advising can be found at Success at Tech.

- 1:1 Tutoring: Students looking for additional assistance outside of the classroom are advised to consider working with a peer tutor through Knack. Georgia Institute of Technology has partnered with Knack to provide students with access to verified peer tutors who have previously aced this course. To view available tutors, visit gatech.joinknack.com and sign in with your student account.

Graduate Student Academic and Professional Success Resources:
A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and
- Professional Development such as the programming from the Career Center and other professional development resources and events"]

Student Well-Being:
At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)

Course Schedule

Unless Entire Class Meeting called for, instructors will meet with sub-teams to review current progress, tasks, and issues.

Week	Date	Activity/Event
Week 1	Aug 27	Entire Class Meeting Introductions Overview of team's work Discussion of semester goals
Week 2	Sept 3	Sub-team selections finalized Sub-team meeting times finalized Brief Instructor Overview of Key Subsystems Group Meeting with Instructor
Week 2-3	Aug 31 – Sept 8	Verification of Student Participation in Class Due by Friday at 4pm
Week 3	Sept 10	Entire class presentations (Kickoff) Assignment: One team member submits slides by start of class Assignment: Self-grade notebook with rubric by start of class
Week 7	Week of Oct 5	Web-based peer-evaluations released for students to complete. Online form due by end of the day Friday. Late submissions will not be accepted.
Week 7	Oct 8	Assignment: Snapshot of individual VIP notebooks submitted for mid-term grading. Midterm presentations Assignment: One team member submits slides by start of class
Week 8	Oct 12	Midterm grades for 2000-level courses due in OSCAR (S for satisfactory, U for unsatisfactory).
Week 10	Oct 31	Withdrawal Deadline
Week 13	Nov 9 – Nov 17 Open Close	Web-based peer-evaluations released for students to complete. Online form closes at 11:59PM on Tuesday. Late submissions will not be accepted.
Week 13	Nov 19	Last day of Class Final presentations Assignment: One team member submits slides by start of class Assignment: Snapshot of individual VIP notebooks taken for final grading.
Finals Week	Dec 10 – Dec 17	No final. No assignments.