



EECE5155: Wireless Sensor Networks and the Internet of Things Course Syllabus

Instructor

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Office Hours:

- Wednesdays, 4-6 PM, on Zoom: <https://northeastern.zoom.us/my/jmjornet>
- Scheduled, on demand

Hourly Course Assistant

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Office Hours: Thursdayss, 10 AM – 12 PM, on Zoom: <https://northeastern.zoom.us/j/93582307514>

Course Meeting Time and Location

Tuesdays and Fridays, 1:35 – 3:15 PM

Snell Library 035

- Live lectures will be streamed through Zoom, following the meeting link on Canvas and available only to registered Northeastern students
- Recorded* lectures will be permanently available in Canvas only to registered students, the hourly course assistant and instructor of this course

**Please contact the instructor if you have any concerns about being recorded.*

Brief Description

Within the last two decades, major breakthroughs in the field of electronics, embedded systems, and wireless communications have paved the way for the development of the Internet of Things (IoT). The IoT defines a truly cyber-physical system in which all sorts of physical devices, ranging from standalone sensors and actuators to home appliances and vehicles, are interconnected and able to autonomously interact with each other. This new form of seamless connectivity is the enabler of many diverse applications in the fields of smart healthcare, home monitoring, and automation, environmental monitoring and pollution control, smart grid and infrastructure management, real-time monitoring of industrial processes, and intelligent transportation of people and goods, among many others. Today, the IoT is the focus of many research initiatives worldwide with multi-billion investments by both governmental agencies and industry.

In this course, the state of the art in communication, networking, and data collection technologies for the IoT will be introduced through a series of theoretical lectures, computer laboratory assignments, and a final project. In the theoretical lectures, the main steps in the data path will be presented, including data acquisition, local data processing, data communication, data stream, data storage & cloud, and data analytics. Special emphasis will be given to the design, modeling, and simulation of communication and networking solutions at all the layers of the protocol stack (from the physical layer to the application layer).

At the appropriate layers, the main communication standards to provide IoT connectivity, such as SigFox, LoRaWAN, and NB-IoT, will be presented. In the laboratory assignments, computer-based experimental assignments with advanced network simulation using ns-3 and monitoring tools such as Wireshark will be conducted to better illustrate and solidify the concepts learned in the class. Finally, students will be grouped and assigned to work on separate virtual projects focused on different application areas of the IoT (e.g., the Internet of Underwater Things, the Internet of Underground Things, the Internet of Nano-Things, etc.). By the end of the semester, students will write a technical report and orally present their work in class.

Objectives and Expected Outcomes

This course will provide the students with the advanced competitive skills required to contribute to the development of the IoT.

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

- Identify and describe the main network architectures and device components of IoT systems
- Identify and describe the main data collection, transmission, storage and analysis tools for the IoT
- Analyze and interpret packet traffic from real telecommunication networks by means of software monitoring tools
- Design and simulate simple network architectures by means of software tools
- Recognize and describe common telecommunication standards and standardization entities
- Participate effectively (and, if needed, remotely) in a team project and assess the strengths and weaknesses of the individual team members (including himself or herself) and the team as a unit
- Find relevant sources of information about a specified topic in the library and on the web
- Write an effective project report to present technical knowledge to a variety of audiences
- Generate an oral presentation on a topic related to class material using electronic tools

Contents

Module T1: Introduction to the Internet of Things

Module T2: Data Acquisition

Module T3: Local Data Processing

Module T4: Data Communication

Module T5: Data Streaming

Module T6: Data Storage & Cloud

Module T7: Data Analytics

Module L1: Introduction to ns-3 and Wireshark

Module L2: Simulation of LoRaWAN networks

Module L3: Routing in Wireless Sensor Networks

Module L4: Development of new protocols for the IoT

Prerequisites (Working Knowledge of)

- EECE 2540. Fundamentals of Networks
- EECE 7374. Fundamentals of Computer Networks

Depth/Breadth Designation

This is a depth course for the CNWS (Computer Networks and Security) concentrations and CSYS (Computer Systems and Software), and breadth for other concentrations.

Organization

- **Homework Assignments:** 2 assignments to be solved individually
- **Laboratory assignments:** 4 assignments to be solved individually or in couples
- **Quizzes:** 2 online quizzes (after Module T4 and after Module T6)
- **Final exam:** there is NO final exam

Grading Policy

Grade Distribution:

- **Homework Assignments:** 25%
- **Laboratory Assignments:** 25%
- **Quizzes:** 25%
- **Final Project:** 25%

Total Points	Final Grade
95-100	A
90-94	A-
85-89	B+
80-84	B
75-79	B-
70-74	C+
65-69	C
60-64	C-
<60	F

Course Materials

All the course materials will be **available in Canvas**:

- Lecture notes
- Additional reading materials
- Homework and laboratory assignments
- Quizzes

Expectations of Students

- Students are expected to act in a professional manner. A student's grade may be reduced (up to 5%) due to unprofessional or disruptive behavior. Please
 - **Use professional style in all communications**, including email, with course instructors and assistants
 - **Respect:** You are expected to treat your instructor and all other participants in the course with courtesy and respect. Your comments to others should be factual, constructive, and free from harassing statements. You are encouraged to disagree with other students and the instructor, but such disagreements need to be respectful and be based upon facts and documentation (rather than prejudices and personalities). Falling to adhere to this expectation may result in a lower grade. Part of the learning process in this course is the respectful engagement of ideas with others.
- To avoid late penalty deductions, assignments should be submitted on or prior to the due date. There will be an automatic 10-point per day deduction in homework assignments submitted past the deadline.
- Students are allowed to share ideas regarding homework problems, but each student must independently write and submit their own solution.
- Makeup quizzes will be given provided that the two following conditions are simultaneously satisfied:
 1. You contact the instructor prior to the exam
 2. You have a valid and documented reason to miss the exam
 - Serious illness or family emergency are acceptable excuses
 - Sleeping in, lack of preparation, ennui, grogginess, etc. are not acceptable excuses

Academic Integrity

A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

Go to <http://www.northeastern.edu/osccr/academic-integrity-policy/> to access the full academic integrity policy.

Student Accommodations

Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability.

For more information, visit <http://www.northeastern.edu/drc/getting-started-with-the-drc/>.

Diversity and Inclusion

Northeastern University is committed to equal opportunity, affirmative action, diversity and social justice while building a climate of inclusion on and beyond campus. In the classroom, members of the University community work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration and an awareness of global perspectives on social justice. It is my intention that students from all backgrounds and perspectives will be well served by this course, and that the diversity that students bring to this class will be viewed as an asset. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, socioeconomic background, family education level, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. Your suggestions are encouraged and appreciated.

Please visit <http://www.northeastern.edu/oidi/> for complete information on Diversity and Inclusion.

Title IX

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance.

Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, faculty and staff.

In case of an emergency, please call 911.

Please visit www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.

Additional Expectations in the time of COVID-19

The university has put into place a robust plan to make the campus healthy and safe for all --- but you must do your part. On August 22, all students received an [email](#) from Senior Vice Chancellor for Student Affairs Madeleine Estabrook on the expectations for behavior both on campus and off campus. **Please read it carefully today.**

To summarize:

1. Gatherings on or off campus must conform to healthy practices as outlined by university and [Massachusetts state guidance](#). If you host or attend an inappropriate party or gathering, you run the very real risk of immediate removal from the community.
2. Wear a mask indoors and outdoors as you maintain a 6-foot distance from everyone.
3. Get tested every three days using the COVID-19 Test Scheduler ([Covid19-testing.northeastern.edu](#).) We may require more frequent testing as the semester progresses. It's quick, easy and will help us to quickly identify and care for anyone who tests positive. I will not be told the identity of anyone who tests positive, and you do not need to share that information with me or anyone else unless you want to. If you receive a positive test result, you will be contacted by a member of the university's telehealth team who will provide you with next steps.
4. Do a Daily Wellness Check ([wellness-check.northeastern.edu](#)), wash your hands well and regularly, and disinfect high-touch surfaces and spaces.
5. I will be wearing a [face covering](#) or mask as I teach and expect that you will do the same in class. If you come to class without a mask, I'll ask you to go and [get one on campus](#). You can get a mask at the Visitor Center or at the Curry Student Center Help Desk. If you refuse to wear a mask in class, I won't be able to continue the class. If you are not sitting six feet apart from your classmate, I'll ask you to do so. We won't be able to eat or drink in class (except water). If you test positive, you will need to enter isolation as directed by the university's telehealth team. I expect that you will not come in-person to class and that you will follow the guidance from the university telehealth team to isolate and get appropriate healthcare if needed.
6. Staying safe is a responsibility that we all must take seriously. Keep in mind the "Protect the Pack" theme. Remember that our individual actions will help everyone stay safe this fall.