

ECE 60022: Wireless Communication Networks
<https://purdue.brightspace.com/d2l/home/1489337>
Spring 2026, Credits: 3

Lectures: Tue/Thu 10:30 pm – 11:45 am ET at BHEE 224

Instructor:

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Office Hours: Wed 4:30 to 5:30 pm in **MSEE 352** or by request.

1 Description

ECE 60022 is a graduate-level course on wireless communication networks. The goal of this course is to provide a rigorous overview of the design and analysis of modern wireless communication systems across multiple layers of the network protocol stack - from physical wireless channels to network-level design, medium access control, and resource allocation mechanisms.

The course will examine a range of wireless networks that arise in practice, including cellular networks, IEEE 802.11 WiFi and Bluetooth systems, satellite and UAV assisted networks, and ad-hoc decentralized networks. Emphasis will be placed on developing mathematical and analytical tools for modeling, analyzing, and optimizing wireless communication systems, while simultaneously engaging with the engineering challenges and constraints that arise in real-world implementations.

2 Learning Outcomes

We believe that by the end of this course, students will be able to:

1. Identify and explain the key components and architectural principles underlying modern wireless communication systems and networks.
2. Develop and apply mathematical tools for modeling, analyzing, and designing wireless communication systems across multiple layers of the protocol stack.
3. Analyze the fundamental tradeoffs and engineering constraints (such as latency, reliability, throughput, energy, and scalability) that arise in practical wireless systems.
4. Critically evaluate the current state-of-the-art in wireless networking research in both academia and industry.
5. Formulate and articulate preliminary research directions and open problems in wireless communication networks.

3 Prerequisites

In the past, ECE 60022 has required ECE 547 (Introduction to Computer Communication Networks) as a pre-requisite. For this offering, while some background understanding of networking (such as in ECE 547) will be helpful, it is not required. Students are expected to have a solid understanding of probability, calculus, linear algebra and digital communications, as would be obtained from a typical undergraduate EE/ECE program. Introductory knowledge of optimization, queuing and machine learning will be useful for some sections of the course.

4 Schedule & Topics

Please note that the plan below is **tentative and the actual content of each week may deviate from the schedule depending on our rate of progress and class interest in specific topics**. I will add weekly readings (lecture notes/papers/surveys/tutorials/book chapters) on brightspace.

Week	Topics
1	Wireless Network Foundations I - history, network layers, propagation, path loss and fading
2	Wireless Network Foundations II - interference, SINR, Stochastic Geometry, Queuing
3	Cellular Networks I - foundations, ORAN, edge computing
4	Cellular Networks II - MIMO, mmWave, THz networking, spectrum sharing
5	WLAN - random access, 802.11, protocols, modeling and analysis
6	NextG Applications - networked control, robotics, ML training & inference, AR/VR
7	Network Optimization - scheduling (Lyapunov/RMAB), power control, multi-objective
8	ML for Wireless - AI native PHY and resource allocation, semantic communication
9	Positioning - cooperative localization, ISAC, beamforming, perception
10	Wireless Security & Resilience - PHY layer security, jamming/spoofing
11-12	Bespoke Topics - UAV+satellite networks, maritime networks, digital twins
13	Project Presentations

5 Assessment & Grading

Homeworks (25%): will be assigned roughly once every three weeks, and will be due at **midnight on Thursdays** unless otherwise indicated. There will be a total of 4 homework sets, equally weighted. We will use gradescope to collect the homeworks.

Exams (35%): There will be two exams throughout the semester, both equally weighted. The first one will be in early March, and the second one will be in mid-April. There is no final exam, and neither of the exams are cumulative. Precise dates and times for the exams will be posted on brightspace.

Project (40%): Most importantly, there will be a “term project”, which will be on a research topic selected by the student (and approved by the instructor). This will be 40% of the final grade. Students are strongly encouraged to discuss potential topics with the instructor early on during the course and also try to tie it with their research interests. Project proposals will be due in early March. The deliverables will be a final report prepared in the format of a 6-page research paper, and a presentation during the last week of classes. You can do projects individually or in groups of two.

6 Collaborations + AI policy + Academic Integrity

We want to foster a collaborative culture, and we encourage discussing the homework assignments with study partners. That said, the homeworks you submit for grading must represent your understanding of the subject matter, and *you should write it up yourself*. If you receive significant

help from other students or online resources, just mention it at the top of your assignment, i.e. you solved problem X with the help of persons A, B, and C; or with the AI model D. Our goal is to encourage discussions and learning, *with proper attribution of credit*.

In assignments/projects that require coding, *you are expected to write your own code*. However, you are welcome to use AI models (LLMs) or other tools such as stackoverflow or WolframAlpha to complete problems (and in particular to write code), since this is how engineering happens in the real world. *We do ask that you list out what tools you used and for what*.

7 Accommodations and DRC

Please contact the course staff **and the DRC** for accommodations related to quizzes and homework submissions as soon as possible. We want to make the course as accessible as we can and the Disability Resource Center (DRC) is a key partner in this work. They can help you figure out what kind of accommodations you might need and help sort out the associated logistical aspects - all we ask is that you inform everyone well in advance.

8 Mental Health and Wellness

We, the course staff, and the University are committed to advancing your mental health and well-being. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, help and services are available. For help, please contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours. Also, please reach out to the course instructor and teaching staff, we're happy to help!

Another option in situations of stress, anxiety and/or when you feel slightly overwhelmed is to try the Therapy Assistance Online (TAO), a new web and app-based mental health resource available courtesy of Purdue Counseling and Psychological Services (CAPS). TAO is available to students, faculty, and staff at any time. If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., you can also sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester.

9 Emergency Preparedness

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on brightspace and can be obtained by contacting the instructors or TAs. You are expected to read your @purdue.edu email on a frequent basis. A link to Purdue's Information on Emergency Preparation and Planning is located on our Brightspace under "University Policies and Statements."