

Course Syllabus: CMPEN 462

Wireless Communication Systems and Security

Catalog Description: Wireless networks cater to diverse applications including smartphone traffic, wearables, medical implants, virtual reality (VR), autonomous cars, drones, data centers etc. The explosion of IoT devices and applications has resulted in an exponentially increasing demand for wireless network data. This course introduces founding principles, architecture, protocols, and algorithms behind the next generation wireless networking systems designed to tackle the growing demand. Topics of discussion include state of the art wireless PHY layer concepts (OFDM, MIMO, beamforming); MAC layer protocols; Routing and TCP; mmWave and 5G networks; gesture recognition, localization, and wireless sensing; wireless security etc. Overall, the course would teach basic wireless networking and instill theoretical concepts necessary to critically analyze modern wireless systems such as LTE/WiFi/BLE/RFID/D2D/V2V. A mini-project would be designed to help develop hands-on skills in wireless system design.

Prerequisites: Basic math and programming maturity (any of MATLAB, R, Python, Java/C). CMPEN 362 Networking. Students without networking background should be willing to read up on the sides.

Instructor: Mahanth Gowda - mahanth.gowda@psu.edu

Office hours: By appointment

Schedule: T/R, 09:05 to 10:20 am, Waring Hall 129

Grading: Homeworks (18%), Programming Assignments: (27%), Mini-Project (25%), Final Exam (25%), Class Participation (5%)

Final letter grades will be curved and the cutoff scores will be determined after all grades are finalized.

Teaching Assistants: Shawn Li (zkl5382@psu.edu), Michael Liu (rml6043@psu.edu)

TA office hours: Shawn Li: (Tue 1:00 - 2:00pm and Thu 1:00 - 2:00pm) W362 Westgate
Michael Liu: (Tue 2:00 - 3:00pm and Thu 2:00 - 3:00pm) W362 Westgate

Topics:

- Physical layer techniques - Synchronization, modulation, multipath, fading, wireless channel
- Physical layer techniques - OFDM/MIMO/Beamforming - the role in efficiency of LTE/WiFi
- Coordination mechanisms and MAC protocols for multi-user network access
- Robotic wireless networks (robots, drones carrying access-points and wireless base-stations)
- Network routing (adhoc, mesh, and sensor networks)
- Transport protocols (TCP over wireless)
- mmWave networks and 5G
- Energy efficiency and battery free communication
- Sensing (Human gestures, imaging objects) and localization
- Security (physical channel as encryption key, radio fingerprinting, location spoofing etc)

Course website (full schedule): http://www.cse.psu.edu/~mkg31/teaching/cmpen_462_sp26/

Reference books:

- [Wireless Networks](#), Nitin Vaidya (UIUC)
- Introduction to Linear Algebra, Gilbert Strang (MIT)
- Understanding Digital Signal Processing, Richard Lyons (UCSC)
- Mathematical Foundations of Computer Networking, Srinivasan Keshav (U. Waterloo)
- A Top Down Approach to Computer Networking, James Kurose (UMass)
- Data Analytics, David Forsyth (UIUC)

Late policy: Late homework submission is accepted until 48 hours after the time of the deadline with a penalty of 20%. No submissions will be accepted after that time.

Emails: Please copy TA Shawn Li (zkl5382@psu.edu) on all emails or other correspondences with the instructor to ensure a timely response.

Online Classes: Up to 8 classes may be held online, zoom link would be provided prior to such classes.

Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights, and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Accommodations for Students with Disabilities

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. Student Disability Resources (SDR) website provides [contact information for every Penn State campus](#). For further information, please visit the [Student Disability Resources website](#).

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: [See documentation guidelines](#). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations request with them as early as possible. You must follow this process for every semester that you request accommodations.

Students with disabilities participating in internship, practicum, student teaching, or other experiential learning opportunities as part of their degree requirements may also be eligible for reasonable accommodations to ensure equal access and opportunity. These accommodations

are determined through an interactive process involving the student, their University supervisor, and the site supervisor. Student Disability Resources can assist students with identifying potential barriers, facilitating accommodation requests, and coordinating with University supervisors to promote inclusive learning experiences.

Counseling and Psychological Services

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

[Counseling and Psychological Services at University Park \(CAPS\)](#)

(<http://studentaffairs.psu.edu/counseling/>): 814-863-0395

Counseling and Psychological Services at [Commonwealth Campuses](#)

(<https://studentaffairs.psu.edu/about/audience/cwc-students>)

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400

Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

Educational Equity and Reporting Bias

Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the [Report Bias webpage](#) (<http://equity.psu.edu/reportbias/>)

Reporting Sexual Misconduct

Sexual misconduct is never tolerated at Penn State. Prohibited conduct includes sexual and gender-based harassment, stalking, sexual assault, and dating violence. These behaviors are not allowed in the classroom, the campus community, labs, or anywhere students, staff, and faculty are located. Prohibited behaviors can include degrading comments such as belittling female-identified students, LGBTQ+ individuals, and gender-diverse students. It can also include harassment, touching someone without their consent, following someone without consent, repeated calls or messaging, physical acts of violence, and more. In other words, professional and appropriate behavior is always expected, and inappropriate or unprofessional behavior is never tolerated. For more information, please refer to the Student Code of Conduct and Penn State Policies AD85 and AD91. ([Title IX Sexual Harassment | Penn State Policies \(psu.edu\)](#) and [Discrimination and Harassment and Related Inappropriate Conduct | Penn State Policies \(psu.edu\)](#))

If you or anyone you know has experienced or is concerned about inappropriate or unprofessional behavior, you can talk with College, or School leadership, your instructor, academic advisor, or another trusted faculty/staff member, report to police or the Office of Sexual Misconduct Reporting & Response ([titleix.psu.edu](#)), or you can seek confidential support and assistance from the Gender Equity Center. The Gender Equity Center supports any student who has had negative relationship experiences including those impacted by sexual violence, relationship violence, stalking, harassment, and other campus climate issues. Services include one on one crisis intervention/support, advocacy,

exploring options, accommodations, safety planning, and referrals. They also promote awareness, build support for survivors, and conduct educational programs and events. All services are free and confidential. [Gender Equity Center | Penn State Student Affairs \(psu.edu\)](https://studentaffairs.psu.edu/gender-equity-center)