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

Teaching Assistants: Hao Zhou (hfz5190@psu.edu), Yilin Liu (yzl470@psu.edu)

Schedule: T/R, 10:35 to 11:50 am, Willard Building 062

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.

Instructor Office hours: T/R, 12:10 to 1:10pm, W314, Westgate Building
TA office hours: Hao Zhou: Tue and Fri 4 - 5pm, 300 West College Ave
                             Yilin Liu: Thu (3:20-4:20pm), Tue (6:20 – 7:20pm), 300 West College Ave

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_sp22/

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.

Academic Integrity: The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. 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 (refer to Senate Policy 49-20. Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9). The CSE Department's has its own statement on Academic Integrity. Academic sanctions for each violation includes a reduction in score for the submission and optionally a reduction of the final letter grade in the course.

Access Statement: Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides contact information for every Penn State campus. For further information, please visit the Student Disability Resources Web site.

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. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services (CAPS) Statement: Students who experience personal issues that interfere with their academic performance, social development or satisfaction at Penn State are encouraged to seek confidential assistance from Counseling and Psychological Services (CAPS) Center (http://studentaffairs.psu.edu/counseling/). They can be reached at (814) 863-0395. Some of the more common concerns they can help with include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. Crisis intervention is available from Centre County

CAN HELP (http://centrecountypa.gov/index.aspx?NID=593) at 1-800-643-5432, 24 hours a day, seven days a week.

Education Equity Reporting Statement: Students who experience themselves or observe any act of intolerance or bias may file a report through Penn State's Educational Equity Office: http://equity.psu.edu/reportbias.

Masking Requirements: Penn State University requires everyone to wear a face mask in all university buildings, including classrooms, regardless of vaccination status. ALL STUDENTS MUST wear a mask appropriately (i.e., covering both your mouth and nose) while you are indoors on campus. This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community.   Anyone attending class without a mask will be asked to put one on or leave. Instructors may end class if anyone present refuses to appropriately wear a mask for the duration of class. Students who refuse to wear masks appropriately may face disciplinary action for Code of Conduct violations. If you feel you cannot wear a mask during class, please speak with your adviser immediately about your options for altering your schedule.