Course Description:

Textbook: Fundamentals of Wireless Communication, David Tse and Pramod Viswanath, Cambridge University Press, 2005 (freely downloadable at): https://web.stanford.edu/~dntse/papers/book121004.pdf
This textbook is to be used only as a reference regarding fundamentals of wireless communication. It explains basic concepts underpinning continuous advances at a level accessible to an audience with a basic background in probability and digital communication.

In addition, several chapters of the following textbook will be used. "Introduction to Wireless Communications and Networks– a practical perspective" K. Raghunandan, Springer 2022. ISBN: 978-3-030-92188-0

Softcopy of this textbook can be accessed online. Access provided by Rutgers University Libraries. The instructor will introduce concepts of the latest technology in cellular such as 4G LTE and 5G systems and use several practical examples from the wireless industry.

Syllabus:

This course introduces the basic principles and applications of wireless communications. It focuses on hands-on projects to bring students closer to real world wireless equipment / devices. In pursuit of this goal, it covers the following topics:

Week 1: The wireless channel; Overview of Cellular systems from 1G to 5G: difference between multiplex and multiple access

Week 2: Point-to-point communication (Free space loss) : Path loss and noise; Doppler, fading, concepts of interference management.

Week 3: Propagation models, Forward Error Correction; PSK and extensions of digital modulations; Channels models used in TDMA, CDMA and OFDM.

Week 4: Over-the-air signal detection, diversity schemes and channel uncertainty; Channel interference mitigation – use of Error Correction Codes.

Week 5: Spectral efficiency, Capacity of wireless channels; Multiuser capacity and opportunistic communication; use of power and its efficiency; 4G LTE structure of resource block; Spectrum usage for different wireless applications

Week 6: Spatial multiplexing and channel modeling. Diversity techniques in space, time and frequency: Orthogonal beams; Beams over the air – MIMO. Multiple beam in 5G services

Week 7: Capacity increase with multiple access; Power density function; deployment of wireless cost and efficiency

Week 8: Spatial multiplexing and channel modeling; pre-coding and applications. MIMO I: MIMO III Diversity multiplexing tradeoff, Universal space time codes.

Week 9: Diversity multiplexing tradeoff, universal space time codes

Week 10 – Week 16: Continuation of Project planning, meetings, discuss progress reports

Course Grading: The grading breakdown:

Category	**Percentage of final grade**
Class attendance	5%
Midterm exam (in class)	25%
Final exam (cumulative, in class)	25%
Hands on Course Projects (Three)	30%
Homework	15%

Note: A significant part of this course involves hands-on projects that are mandatory and are not group assignments. These begin from week 4 onwards.

Each student will work on projects. Its objective, results and conclusion will be presented as a report by each student. Homework problems assigned must be worked on and submitted - they carry 15% towards final grade.

Mid-term and final Exams are in person - conducted during the class hours.

Office Hours: After class or scheduled via email.