ECE614 Communications over Fading Dispersive Channels

Instructor: Dr. Mushu Li, mushu.li@uwaterloo.ca

Teaching Assistant: TBA

Lectures: [redacted]

Course Material: Lecture notes/slides, tutorial slides and videos, reference research papers, homework assignment, along with any relevant information, are organized in the 12 weekly directories.

Tutorials: [redacted] (The course is jointly held with ECE 414, which has tutorial sessions. Additional tutorial videos are available on LEARN)

Office Hour: TBA

Course Website: https://learn.uwaterloo.ca

Course Outline: This course focuses on fundamentals of wireless communications and networking for systems such as cellular networks and wireless local area networks (WiFi). It extends the studies of digital communications over an additive white Gaussian noise (AWGN) channel to a fading dispersive channel in a mobile environment. After a brief introduction to the five generations of cellular communication systems, we start with modeling a wireless propagation channel as a linear time variant system, and study digital modulation schemes used in the physical-layer transmission of wireless system standards. We also study how to mitigate channel impairments in transceiver design, such as using diversity to overcome channel fading. After that, we will learn the fundamentals for cellular systems at the system level in terms of frequency reuse to enlarge system capacity. To support multiple mobile users, we will study how to permit multiple access of the common radio resources (i.e., to avoid interference in simultaneous transmissions from multiple users), using techniques such as code division multiple access (CDMA). There are six chapters in lecture notes and slides:

1. Overview of wireless communications;
2. Characterization of wireless channels;
3. Bandpass transmission over wireless channels;
4. Channel impairment mitigation techniques;
5. Fundamentals of cellular communications;
6. Multiple access techniques.

Prerequisites: ECE206, and ECE318 or equivalent (subject to the approval of instructor)

Lecture Notes: J.W. Mark and W. Zhuang, Wireless Communications and Networking.

Homework Assignments: Problems and solutions will be posted on the course website.

Reference Books: (Course reserves at the DC library for online access)

1. R. S. Kennedy, Fading Dispersive Communication Channels, Wiley-Interscience, 1969.
2. G.L. Stuber, Principles of Mobile Communications, 4th ed., Kluwer Academic Publishers, 2017.
3. M. Schwartz, W.R. Bennett, and S. Stein, Communication Systems and Techniques, McGraw-Hill Book Company, 1996.
4. S. Haykin. Communication Systems. 4th ed. John Wiley & Sons, 2001
5. S. Haykin. Digital Communication systems. John Wiley & Sons, 2014
6. M. Şafak, Digital Communications. John Wiley & Sons, 2017
7. R.E. Ziemer and R.L. Peterson, Digital Communications and Spread Spectrum Systems. New York: Macmillan, 1985

Project: Each student should choose a topic related to the course subject (with an approval from the instructor, please email project topic and abstract with 3 key journal paper references), conduct a literature survey on the topic, carry out performance evaluation of a solution in the references, write a report (of 6000 – 8000 words) on understanding and insights on the topic with 10-15 key references, and give a 10-15 minute presentation to the class.

Grading: Project= 40%, Homework = 20%, and Exam = 40%. There will be 10% deduction per day for late homework and project report submission. No show for project presentation will result in a grade of zero.

Homework and Project Report Format: Unless specified otherwise, all written work must:

- Include a Title Page with Student Name and Number
- Be double-spaced
- Use 12pt Times New Roman font
- Use one inch margins all around
- Have numbered pages
- Use paragraphs (point form notes are not acceptable)
- Use current APA formatting for in-text citations and referencing

distribution (e.g. uploading material to a commercial third-party website) may lead to a violation of Copyright law.

Assignment and Project Report Submission and Lateness Penalties: Proper academic performance depends on students doing their work not only well, but on time. Accordingly, the assignment is due by 11pm on its due date and you are required to upload your assignment online via Crowdmark in the course website in Learn. Unless otherwise indicated, e-mailed assignments will not be accepted. An assignment is considered LATE if uploaded after 11:00pm on the due date. Late assignments will be penalized with a 10% grade reduction per day, unless they are accompanied by a doctor's or by other official documentation detailing a serious matter.

Policy on Academic Integrity

Academic Integrity: To maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and responsibility. A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for their actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from course instructor, academic advisor, or Graduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71- Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71- Student Discipline, https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71.

Grievance: A student who believes that a decision affecting some aspect of their University life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70: Student Petitions and Grievances, Section 4, https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70.

Appeals: A student may appeal the finding and/or penalty in a decision made under Policy 70: Student Petitions and Grievances (other than regarding a petition) or Policy 71: Student Discipline if a ground for an appeal can be established. Read Policy 72: Student Appeals, https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-7 .

Academic Integrity Office (UW): https://uwaterloo.ca/academic-integrity/.