

Winter 2023

## ECE-7650-T26– Advanced Wireless Communication

### COURSE DESCRIPTION:

This course provides advanced knowledge for modeling, analysis, and design of multi-antenna (MIMO) communication for modern wireless data transmission systems.

### COURSE OBJECTIVE:

The use of multiple antennas at both sides of the communication link has enabled substantial improvements of modern communication systems in terms of data rate, reliability, and coverage (e.g. 4G and 5G cellular systems). This course will expose the student to the fundamentals as well as the recent advances in multi-antenna communications from information theory as well as signal processing perspectives. The course will start with a primer on information theory and MMSE estimation before covering several single-user and multiuser transmissions techniques with optimal and suboptimal transceivers. As a graduate level course, it will also include research project component done by the students.

### PRE-REQUISITES:

Undergraduate background in digital communication systems.

### CONTACT HOURS:

3-hours per week

### COURSE CONTENT:

- Part I (Wireless Communication Theory): Information theory and MMSE estimation, Entropy and mutual information, channel modeling, SISO communication
- Part II (Single User MIMO): Optimal receivers, optimal linear receivers.
- Part III (Multiuser MIMO): Optimal transceivers, optimum linear transceivers, massive MIMO.

Additional advanced research topics as determined by the instructor.

### HOMEWORK:

Homework will consist of assignments and an individual design project.

### TEXTBOOK:

Foundations of MIMO Communication: Heath Jr., Robert W., Lozano, Angel.

### GRADE ANNOUNCEMENTS:

*Grades for this course will be announced by May 2023*

## EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination. **Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.**

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars				
Assignments	5	25%	25	
Project	1	25%	25	
Mid-Term Exam				
Final Examination	1	50%	50	
<b>TOTAL</b>			100	

## GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

## INSTRUCTOR INFO:

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Office Hours: ..... By appointment

## VOLUNTARY WITHDRAW:

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## REQUIREMENTS/REGULATIONS

**Student Responsibilities:** It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc..

**Lectures:** Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

## ACADEMIC INTEGRITY

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism\* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

**\*Plagiarism:** to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source