

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Ininiwak, Anisinenewuk, Dakota Oyate and Dene, and on the National Homeland of the Red River Métis.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

WINTER 2025

ECE 7650 – Topics in Space-Air-Ground Integrated Networks

COURSE DESCRIPTION:

This graduate course provides a structured approach to the design of the emerging space-air-ground integrated networks. Topics will include radio-frequency and free-space optical communications, networking, standards, and AI techniques from the current research literature.

COURSE OBJECTIVE:

Recent advancements in space-air-ground integrated network (SAGIN) systems — including low-Earth orbit (LEO) satellite constellations and aerial platform stations — hold great promise for delivering high-quality network infrastructure and services to anyone, anywhere. As a SAGIN system encompasses heterogeneous and complex entities, a systematic design methodology is essential to guide the development of such systems. This course provides a structured framework for the design and development of SAGIN systems, with particular emphasis on the fundamental principles of communications, networking, and AI and machine learning as applied to system design.

PRE-REQUISITES: (one required)

ECE 4260 - Communication Systems (or equivalent) **OR**

ECE 4240 - Microprocessor Interfacing (or equivalent)

CONTACT HOURS:

2-hours per week

COURSE CONTENT:

The following topics will be discussed:

- Network architectures and integration modes
- Radio-frequency communications in space-ground links
- Free-space optical communications in inter-satellite links
- Standards and network protocols in SAGINs
- Applications of SAGINs
- AI/ML techniques for SAGINs
- Challenges and future trends

Additional advanced research topics as determined by the instructor.

HOMEWORK:

Homework will consist of assignments, preparation of a seminar on an assigned article from the research literature, and an individual design project.

TEXTBOOK:

TBD

GRADE ANNOUNCEMENTS:*Grades for this course will be announced by May 2027***EVALUATION:**

Your final course grade is determined by your performance in the components list below in the Evaluation Table. Students must complete and pass all components in the course to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars	1	10%	10	
Assignments	4	5%	20	
Project	1	30%	30	
Final Examination	1	40%	40	
TOTAL			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:

Name:..... Peng Hu
 Office:..... SP-326 Stanley Pauley Engineering Building
 Tel:..... (204) 474-6294
 Email:..... Peng.Hu@umanitoba.ca

Office Hours: By appointment

VOLUNTARY WITHDRAW:**March 22, 2027****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 the 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 on Academic Integrity, students are reminded that plagiarism* or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). **This includes the unauthorized use of AI when preparing course deliverables.** A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. **Integrity also applies to respecting copyrighted course content, which should not be distributed without the creator's permission. Uploading content for the purpose of transcription or other AI-enabled features is commonly a violation of the copyright holder's rights.**

Copyright

All materials provided in this course are copyright and are provided under the fair dealing provision of the Canadian Copyright Act. This material may not be redistributed in any manner without the express written permission of the relevant copyright holder. **This includes recording class sessions for personal use and/or uploading any course materials to a website.**

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