ECE 759
Special Topics in Microwaves and Photonics: Advanced Optical Wireless Communications

COURSE OUTLINE

Please refer to course website for updated information.

CALENDAR DESCRIPTION

Due to the abundant reusable license-free optical spectrum, Optical Wireless Communications (OWC) has become a promising technology for enabling future wireless communication networks, including beyond fifth-generation/sixth-generation (B5G/6G) mobile communication networks, to cope with the explosive increase in the demand for high data-rate communications and the massive connectivity of the emerging Internet-of-Things (IoT). This course will provide an overview of the fundamentals of the theory and practical implementations of OWC. Four important aspects of OWC will be covered: (i) the fundamental principles of OWC, (ii) devices and systems, (iii) modulation techniques, and (iv) channel models and system performance analysis. Different challenges encountered in OWC as well as possible solutions and current research trends will also be covered.

SCHEDULE And MODE OF DELIVERY

This course will be offered in person.

Lecture: Three hours per week
Lab: Not applicable

INSTRUCTOR

Dr. Telex M. N. Ngatched
Email: ngatchet@mcmaster.ca
Office: ITB-110
Phone: 905-525-9140 ext. 21238
Office Hours**:** By appointment

COURSE WEBSITE/S

http://avenue.mcmaster.ca

COURSE OBJECTIVES

By the end of this course, students should be able to

- Understand the principle of OWC devices and systems
- Model the channel for indoor and outdoor OWC systems
- Understand different modulation schemes and different multiple access techniques for OWC systems
- Understand the transceivers design considerations for OWC systems
- Understand the principle of visible light communications
- Understand how to utilize OWC in sensor networks

ASSUMED KNOWLEDGE

Basic understanding of vector algebra and signals and systems at the undergraduate level.

COURSE MATERIALS

Textbooks:

Lecture notes will be provided. No textbook is required.

Reference Textbooks:

1. Z. Ghassemlooy, W.Popoola, and S. Rajbhandari, *Optical Wireless Communications-Systems and channel modelling with MATLAB*, CRC press, Taylor & Francis, 2013.
2. Shlomi Armon, John R. Barry, George K. Karagiannidis, Robert Schober, and Murat Uysal, *Advanced Optical Wireless Communication Systems,* Cambridge university press, 2012.
3. Steve Hranilovic, *Wireless Optical Communication Systems*, Springer New York, 2005.
4. Murat Uysal, Carlo Capsoni, Zabih Ghassemlooy, Anthony Boucouvalas, and Eszter Udvary, *Optical Wireless Communications - An Emerging Technology*, Springer International Publishing Switzerland, 2016.
5. Ivan B. Djordjevic, *Advanced Optical and Wireless Communication Systems,* Springer International Publishing AG, 2018.
6. Roberto Ramirez-Iniguez, Sevia M. Idrus, and Ziran Sun, Optical wireless communications: IR for wireless connectivity, CRC Press, Taylor and Francis Group, 2007.
7. Recent literature in Optical Wireless Communications.

Other:
MATLAB

COURSE OVERVIEW

Week	Topic
1	Introduction: Optical Wireless Communication Systems
2	Optical Sources
3	Optical Detectors
4	Modeling and Characterization of Indoor Optical Wireless Communication Channel
5	Modeling and Characterization of Outdoor Optical Wireless Communication Channel
6	Modeling of Underwater Optical Wireless Communication Channel
7	Modulation Techniques
8	Modulation Techniques
9	System Performance Analysis of Indoor OWC Links
10	System Performance Analysis of Outdoor OWC Links
11	Multiple-Input Multiple-Output Techniques in OWC
12	Visible Light Communications
13	Optical Wireless in Sensor Networks

At certain points in the course it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on the course website).

ASSESSMENT

Component	Weight	Due Date
Assignments (3 x 20%)	60%	One week after assignment is given
Project	40%	Last day of classes
Total	100%	

Late submissions of assignments or project report are subject to 20% penalty per day (less than one day is counted as one day).

CONDUCT EXPECTATIONS

As a McMaster graduate student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect,

disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

ACADEMIC ACCOMMODATIONS OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.

www.eng.mcmaster.ca/ece