

**ELEC ENG 4EM4**  
**Photonic Devices and Systems**  
Winter 2017  
Course Outline

**CALENDAR/COURSE DESCRIPTION**

Fundamentals of light, Optical fibres and light propagation characteristics, Lasers and photo-diodes as the light source and detectors, Optical amplifiers and modulators, Fibre-optic telecommunication and data communication systems and networks

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): Registered in Level III or greater in any Electrical or Computer Engineering Program, ELECENG 3EJ4 or PHYSICS 3BA3 and PHYSICS 3BB3  
Antirequisite(s): ELECENG 4EM3, ENGPYS 4K03

**SCHEDULE**

**Lectures:** Mondays and Wednesdays 11:30 am – 12:20 pm, Fridays 1:30 pm – 2:20 pm

**Tutorial:** Tuesdays 8:30 am – 9:20 am

**Labs:** Every Other Week: L01/L02 Mondays 2:30 pm – 5:20 pm, L03/L04 Tuesdays 2:30 pm – 5:20 pm, L05/L06 Wednesdays 2:30 pm – 5:20 pm, L07/L08 Thursdays 2:30 pm – 5:20 pm, L09/L010 Fridays 2:30 pm – 5:20 pm

**INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION**

**Dr. Xun Li**  
ITB-A313  
[lixun@mcmaster.ca](mailto:lixun@mcmaster.ca)  
ext. 27698

**Office Hours:**  
Mondays 12:30 pm – 1:30 pm  
Wednesdays 12:30 pm – 1:30 pm

**TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION**

Name	Office	Extension	E-mail	Office Hours
Zhao, Sangzhi	ITB-A204	24087	zhaosangzhi@gmail.com	TBD
NaghshvarianJahromi, Mahdi	TBD	TBD	TBD	TBD
Bidaki, Elham	TBD	TBD	TBD	TBD
Redhwan, Md.	TBD	TBD	TBD	TBD

**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

Course website will be ready by Dec. 31, 2016. For questions, contact Dr. Xun Li through [lixun@mcmaster.ca](mailto:lixun@mcmaster.ca) directly.

### COURSE OBJECTIVES

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

- develop knowledge on operating principles of photonic devices and optical fibres;
- design methodologies and analyzing techniques of lightwave communication systems;
- model simple fibre optic communication systems;
- gain hands-on experience on fibre-splicing and fibre optic systems design.

### ASSUMED KNOWLEDGE

Electromagnetics  
Signals and systems  
Communication systems  
Electronic circuits

### COURSE MATERIALS

**Required Texts:**

“Fibre-Optic Communications: Fundamentals and Applications”, S. Kumar and M. J. Deen, John Wiley and Sons, 2014.

**Calculator:**

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

**Other Materials:**

“Fibre-Optic Communications Systems”, 3<sup>rd</sup> Edition, G. P. Agrawal, Wiley Inter-science, 2002.

### COURSE OVERVIEW

<b>Week 1</b>	Introduction: from analogy to digital communication, from point-to-point system to networking	Lecture Notes
<b>Week 2</b>	Basics of optics: from ray optics to wave optics	Lecture Notes
<b>Week 3</b>	Optical channels I: free space, optical fibres, and optical waveguides	Lecture Notes
<b>Week 4</b>	Optical channels II: optical pulse propagation in fibre	Lecture Notes
<b>Week 5</b>	Optical transmitters I: light source and driving circuits	Lecture Notes
<b>Week 6</b>	Optical transmitters II: transmitter design	Lecture Notes

<b>Week 7</b>	Optical receivers I: photo-detectors and receiver circuits	Lecture Notes
<b>Week 8</b>	Optical receivers II: receiver design	Lecture Notes
<b>Week 9</b>	Optical transmission system design	Lecture Notes
<b>Week 10</b>	Advanced topics I: wavelength division multiplexing, coherent lightwave systems	Lecture Notes
<b>Week 11</b>	Advanced topics II: spatial division multiplexing, optical angular momentum division multiplexing	Lecture Notes
<b>Week 12</b>	Advanced topics III: reconfigurable optical add/drop multiplexer and advanced photonic networks	Lecture Notes

**LABORATORY OVERVIEW**

Date/Week	Topic	Readings
<b>Week 1</b>	Lab introduction and familiarization with the lab-kit	Lab volt manual
<b>Week 2</b>	Optical fibres	Lab volt manual
<b>Week 3</b>	Optical transmitters	Lab volt manual
<b>Week 4</b>	Optical transmission systems	Lab volt manual

**LABORATORY OPERATION**

The students should work individually and finish a report after each experiment. The lab marks are based on the lab performance and report.

**ASSESSMENT**

Component	Weight
Assignments	20%
Labs	20%
Midterm	10%
Final Exam	50%
<b>Total</b>	<b>100%</b>

4 assignments - worth 5% each, 4 labs – worth 5% each, 1 midterm test - worth 10%, and final exam - worth 50%

The final exam will test *cumulative* knowledge!

### ACCREDITATION LEARNING OUTCOMES

Note: The *Learning Outcomes* defined in this section are measured throughout the course and form part of the Department’s continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student’s actual grade in the course. For more information on accreditation, please ask your instructor or visit:

<http://www.engineerscanada.ca>.

Outcomes	Indicators	Measurement Methods(s)
Basic understanding of light propagation and interaction in photonic devices (linked to accreditation measurement - knowledge base for engineering).	1.4	Midterm
Hands on experience on optical fibre splicing and optical communication system consisting of transmitter, fibre, and receiver.	8.2	Lab safety quiz
Will be capable of selecting appropriate model and methods to model/design fibre optic systems (linked to accreditation measurement - investigation).	3.2	Final Exam

### ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

#### **ACADEMIC ACCOMMODATIONS**

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at [sas@mcmaster.ca](mailto:sas@mcmaster.ca). For further information, consult McMaster University's Policy for [Academic Accommodation of Students with Disabilities](#).

#### **NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK**

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar - "Requests for Relief for Missed Academic Term Work": <http://www.mcmaster.ca/msaf/>

#### **NOTICE REGARDING POSSIBLE COURSE MODIFICATION**

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

#### **ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK**

In this course, we will be using web-pages. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

## Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory.

### General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.

### Location of Safety Equipment

#### Fire Extinguisher

On walls in halls outside of labs

#### First Aid Kit

ITB A111, or dial "88" after 4:30 p.m.

#### Telephone

On the wall of every lab near the door

#### Fire Alarm Pulls

Near all building exit doors on all floors

## Who to Contact

**Emergency Medical / Security:** On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

**Non-Emergency Accident or Incident:** Immediately inform the TA on duty or Course Instructor.

**University Security (Enquiries / Non-Emergency):** Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

**See TA or Instructor:** For problems with heat, ventilation, fire extinguishers, or immediate repairs

**Environmental & Occupational Health Support Services (EOHSS):** For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

**ECE Specific Instructional Laboratory Concerns:** For non-emergency questions specific to the ECE

## In Case of a Fire (Dial 88)

**When calling to report a fire, give name, exact location, and building.**

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.

6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

## Clothing on Fire

### Do not use a fire extinguisher on people

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

## Equipment Failure or Hazard

### Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behavior of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

## Protocol for Safe Laboratory Practice

### Leave equipment in a safe state for the next person - if you're not sure, ask!

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

## Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer - ITB 147	steve@mail.ece.mcmaster.ca
ECE Chair	Tim Davidson - ITB A111	davidson@mcmaster.ca
ECE Administrator	Kerri Hastings - ITB A111	hastings@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	