

**ELEC ENG 3FK4**  
**Electromagnetics II**

COURSE OUTLINE

Please refer to course website for updated information.

**COURSE DESCRIPTION**

Time-varying fields, uniform plane waves, reflection and transmission, dispersion, transmission lines and impedance matching, waveguides, elements of theory of radiation and antennas.

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): Registration in any Computer Engineering, Engineering Physics or Electrical Engineering Program, ELECENG 2FH3 or ENGPYHS 2A04

**SCHEDULE**

Lecture: Monday, Thursday 12:30pm - 1:20pm, MDCL 1105; Tuesday 1:30pm - 2:20pm MDCL 1105

Tutorial: Wednesday 9:30am - 10:20am, HH 109

Lab: *EOW (Every other week)* - L01/L02 Mondays 2:30pm - 5:20pm; L03/L04 Tuesdays 2:30pm - 5:20pm; etc. ITB-154; L11 Tuesday 5:30pm - 8:20pm ITB-154

**INSTRUCTOR**

Dr. Timothy R. Field

Email: field@mcmaster.ca

Office: ITB-A215

Phone: 905-525-9140 ext. 24194

Office Hours: Thursdays 2:30pm - 4:00pm, and by appointment

**TEACHING ASSISTANTS**

Contact information and office hours are provided on the course website.

- Venkata Pydimarri
- Anbang Deng
- Prabnanjan Mannari
- Ryan Ramdial
- Elham Bidaki

**COURSE WEBSITE/S**

<http://www.ece.mcmaster.ca/~field/courses/ee3fk4>

**COURSE OBJECTIVES**

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

- gain knowledge on the basic principles of time-varying electromagnetic field
- understand the basics of transmission lines and antenna.
- solve engineering problems related to electromagnetic propagation
- design simple devices that require the knowledge of electromagnetic field

**ASSUMED KNOWLEDGE**

Electrostatics and Magnetostatics

**COURSE MATERIALS**

Required Texts:

“Elements of electromagnetics”, 6th ed. N. O. Sadiku, Oxford University Press, ISBN 978-0-19-538775-9

Calculator:

Use of any calculator is permitted

Other:

“Engineering Electromagnetics”, W.H. Hayt Jr. and J. A. Buck, Eighth Edition, McGraw Hill. ISBN 978-0-07-338066-7

**COURSE OVERVIEW**

Week	Topic	Readings
1	Vector calculus review	Ch. 1-3
2	Review of electrostatics	Ch. 4-6
3	Review of magnetostatics	Ch. 7-8
4	Time varying Fields- Faraday's Law and displacement current	Ch. 9
5	Time varying Fields - Maxwell's equations	Ch. 9
6	Uniform Plane wave	Ch. 10
7	Plane wave reflections	Ch. 10
8	Poynting's Theorem and wave power	Ch. 10
9	Transmission Lines	Ch. 11

10	Waveguides	Ch. 12
11	Waveguides	Ch. 12
12	Antennas	Ch. 13
13	Review	-

A more detailed time line is available on the course web site.

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).

#### LABORATORY OVERVIEW

Week	Topic
3-4	Faraday's Law
5-6	Electromagnetic field
7-8	Transmission Line
9-10	Antennas

#### LABORATORY OPERATION

- At the beginning of every term, every Undergraduate student using an ECE Lab is required to complete the ECE Lab Safety Quiz (one completed quiz covers every course that term). The quiz and other information is provided on the webpage: <https://www.eng.mcmaster.ca/ece/resources#health-safety>
- Access to all labs is restricted in the interest of security and safety. Information on accessing and using the lab can be found on the webpage: <https://www.eng.mcmaster.ca/ece/labs-and-health-safety#Labs-Access-and-Use>
- Please obtain your own Access Card for use during regular building hours / The TA will open the lab at regularly scheduled lab times
- The labs for this course will be held in ITB-154
- The labs will be performed in groups of two students
- Each lab will involve a significant amount of pre-lab work. You may submit one pre-lab report per group, or you can submit your own pre-lab, should you so wish.
- The pre-lab work will be assessed at the beginning of the lab. The penalties for late pre-lab work are as follows. Pre-lab received by TAs before 2:45pm: No penalty. Pre-lab received by TAs between 2:45pm and 3:00pm: A penalty of 50% of the awarded mark will be applied. Pre-lab not submitted before 3:00pm: No marks will be awarded for the pre-lab component, but you will be allowed to attempt the experiments.
- The TAs and the instructor reserve the right to interview students to assess their understanding of the per-lab material. Such interviews will be held at random and we reserve the right to adjust the pre-lab mark based on the outcome of the interview.

### ASSESSMENT

Component	Weight
Labs	20 %
Midterm	25 %
Final Exam	55 %
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).

No make-up midterm tests will be granted. Weight of a missed midterm test will be transferred to final exam.

### 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 Method(s)
Maxwell's equations and propagation of uniform plane wave in dielectrics and conductors	1.4	Assignment / test / exam
Derive reflection and transmission coefficients for plane waves at normal incidence for various types of media	2.2	Assignment / test / exam
Appreciate interplay between theory and experiment for transmission lines, operating lab equipment correctly, gathering valid measurements and interpreting them correctly through the transmission line equations.	5.2	Lab 3
Apply Maxwell's equations to obtain rectangular waveguide modes, cut-off frequency, dominant mode, wave impedance and field line patterns for various cross sections	1.4	Assignment / test / exam
Hertzian dipole and antenna specifications	1.2	Lab 4

## 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 [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

The following illustrates only three forms of academic dishonesty:

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

## ACADEMIC ACCOMMODATIONS

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail [sas@mcmaster.ca](mailto:sas@mcmaster.ca). For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to the Engineering Student Services 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.

## 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".

## 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.

#### ONLINE ACCESS OR WORK

In this course we will be using *LabVolt*. 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.

[www.eng.mcmaster.ca/ece](http://www.eng.mcmaster.ca/ece)

## Electrical and Computer Engineering Lab Safety

### 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 laboratories, please contact 24103.

## 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 behaviour 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 Course Instructor	Please contact your specific course instructor directly	
ECE Administrator	Kerri Hastings- ITB A111	hastings@mcmaster.ca
ECE Chair	Tim Davidson- ITB A111	davidson@mcmaster.ca