

Electrical and Computer Engineering
ELECENG 4FJ4
Devices and Antennas for Wireless
Systems
Fall 2024



ENGINEERING

Instructor Information

Natalia K. Nikolova

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Office: ITB-A308

Office Hours:

Tuesday from 10 am to 11 am, Wednesday from 2 pm to 3 pm

By appointment or twice a week on fixed hours as specified, in-person (in ITB-A308) or online (call the instructor on MS Teams).

The A2L course webpage will announce any changes that may occur in the Office Hours.

Class Times

Lectures:

Tuesday, Wednesday, Friday, from 12:30 pm to 1:30 pm.

Lectures will be recorded on Echo 360. Pre-recorded lecture previews are available through YouTube. Links to the YouTube videos are provided through the Avenue To Learn (A2L) course webpage. Watching the lecture previews is recommended before the in-person lecture.

Tutorials:

Wednesday 8:30 am – 9:20 am.

Tutorials will be recorded on Echo 360.

Labs:

Five lab modules in total involve microwave and antenna measurements. The labs are carried out from 2:30 pm to 5:30 pm in person. Labs do not depend on the lecture or tutorial material but require self-preparation through the provided DISCUSSION section in each Lab Module Workbook. Since lab sections are scheduled every other week, the labs stretch over a 10-week period. Details are provided below.

- Lab modules are timed for 3 hours, which include the completion of the Lab Report.
- Each Lab Module will be offered for a period of two weeks.
- Lab sessions start on Monday Sep. 16 (week 3) and end on Friday Nov. 29, 2024 (week 12).
- Changing the regular lab attendance time slot is permitted but must be completed by Friday Sep. 13, 2024. The schedule must aim at spreading out attendance to no more than 4 persons per session. This ensures quality interaction with the TA and individual access to measurement equipment.
- One-time change of lab section is allowed after Friday Sep. 13, 2024, provided the student obtains a permission from the TA responsible for the lab session.
- Missed lab work can be completed during the last week of the term (week 13), from Dec. 2, 2024, to Dec. 5, 2024, inclusive. Students are encouraged to schedule a 3-hour time slot in advance with a lab TA.
- Lab sections are numbered from L01 to L10, where odd-numbered sections start on Monday Sep. 16, 2024, whereas even-numbered sections start on Monday Sep. 23, 2024. See table below for details.

Start on Monday Sep. 16	Start on Monday Sep. 23
L01 Mondays 2:30 pm – 5:20 pm	L02 Mondays 2:30 pm – 5:20 pm
L03 Tuesdays 2:30 pm – 5:20 pm	L04 Tuesdays 2:30 pm – 5:20 pm
L05 Wednesdays 2:30 pm – 5:20 pm	L06 Wednesdays 2:30 pm – 5:20 pm
L07 Thursdays 2:30 pm – 5:20 pm	L08 Thursdays 2:30 pm – 5:20 pm
L09 Fridays 2:30 pm – 5:20 pm	L10 Fridays 2:30 pm – 5:20 pm

Course Dates: 09/03/2024 - 12/05/2024

Units: 4.00

Course Delivery Mode: In Person

Course Description: This course provides the fundamentals of the technology of wireless communications. transmission lines and waveguides, scattering parameters, impedance matching, power dividers, directional couplers, microwave resonators and filters, microwave sources and active devices, antenna fundamentals, microwave and antenna measurements. Three lectures, one tutorial, one lab every other week; first term
Prerequisite(s): ELECENG 2FL3 or ELECENG 3FK4 or ELECENG 2CF3

Pre-Requisite(s) and Anti-Requisite(s)

Pre-requisite(s): ELECENG 2FL3 or 3FK4

Anti-requisite(s): None

Important Links

- [Mosaic](#)
- [Avenue to Learn](#)
- [Student Accessibility Services - Accommodations](#)
- [McMaster University Library](#)
- [eReserves](#)

Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) is a division of Engineers Canada and is responsible for accrediting undergraduate engineering programs across Canada. Accreditation by the CEAB ensures that the engineering programs meet a national standard of quality and cover essential educational requirements. Graduate Attributes are a set of qualities and skills that the CEAB expects engineering graduates to possess. These attributes are a benchmark for the learning outcomes of accredited

engineering programs. This section lists the Graduate Attribute Indicators associated with the Learning Outcomes in this course.

Course Learning Objectives

- By the end of this course, students should be able to:
 - understand the operational principles and the system architecture of the radio-frequency receiving and transmitting equipment (Indicator 2.1);
 - perform analysis and design of simple impedance-matching circuits using the Smith Chart (Indicator 4.3);
 - perform microwave circuit analysis in terms of scattering parameters (Indicator 2.1);
 - use basic microwave test instrumentation (signal generators, oscilloscopes, spectrum analyzers and vector network analyzers) to measure single-port and multi-port microwave devices and antennas (Indicators 4.3, 5.2);
 - use professional design software for microwave circuit analysis and design (Indicators 2.1, 4.3, 5.2);
 - use professional design software for antenna analysis and design (Indicators 2.1, 4.3, 5.2);
 - fabricate and test simple circuit and antenna prototypes using microstrip technology (Indicators 2.1, 4.3, 8.2, 9.1);
 - understand fabrication tolerances and their impact on the circuit performance (Indicators 2.1, 5.2, 8.2);
 - write technical documentation and propose further improvements on existing wireless technology solutions (Indicators 8.2, 9.1).

CEAB Graduate Attributes (GAs)

The CEAB Graduate Attributes (GAs) 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>

Attributes	Indicators		Measurement Method(s)
	Number	Description	
Problem Analysis	2.1	Identifies and states reasonable assumptions and suitable engineering fundamentals, before	Final Exam mark

		proposing a solution path to a problem	
Design	4.3	Develops models/prototypes; tests, evaluates, and iterates as appropriate	Design Project mark
Use of Engineering Tools	5.2	Demonstrates an ability to use modern/state of the art tools	Lab mark
Professionalism	8.2	Integrates appropriate standards, codes, legal and regulatory factors into decision making	Assignment 1 mark (RF Safety: Standards, Measurements, Compliance)
Impact of Engineering on Society and the Environment	9.1	Evaluates the environmental impact of engineering activities, identifies uncertainties in decisions, and promotes sustainable design	Overall Assignment mark

Lab Safety

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs". It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety programs and policies. For information on these programs and policies please refer to [McMaster University Health and Safety](#). The Lab Safety Handbook is available [here](#), as well as on A2L.

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for some of the experiments and the laboratory equipment. A laboratory-specific set of rules can also be added to ensure that students fully understand laboratory safety rules that are in place prior to their first session.

Assumed Knowledge

- Wave Equation and Maxwell's Equations
- Fundamentals of Transmission Line Theory

Required Materials and Texts

Textbook Listing: <https://textbooks.mcmaster.ca>

preview lectures available on YouTube

Authors: Natalia K. Nikolova

Links to videos provided in the course A2L shell

lecture notes and lecture/tutorial solved examples posted on course A2L webpage

Authors: Natalia K. Nikolova

laboratory workbooks posted on course A2L webpage

Authors: Natalia K. Nikolova

Fundamentals of Microwave and RF Design

ISBN: 1469656884

Authors: Michael Steer

Publication Date: 2019

Edition: 3rd

made freely available by author at <https://repository.lib.ncsu.edu/handle/1840.20/36776>

(look under "Files in this item")

AWR Microwave Office: Software tool for microwave circuit analysis and design

Software is freely available to McMaster students for a period of 6 months. Instructions for download and installation are provided on the course A2L webpage.

Altair FEKO: Software tools for antenna analysis and design

Software student version is freely available. Instructions for download and installation are provided on the course A2L webpage.

Optional Course Materials

Textbook Listing: <https://textbooks.mcmaster.ca>

Microwave Engineering

ISBN: 0470631554

Authors: D. M. Pozar

Publisher: Wiley

Publication Date: 2011

Edition: Any

Copies available in THODE

Microwave and RF Design: A Systems Approach

ISBN: 189112188X

Authors: Michael Steer

Publisher: SciTech

Publication Date: 2010

Edition: Any

Copies available in THODE

Class Format

In Person

Course Schedule

Week	Topic	Readings
1	Radio Systems: An Overview Tech. Brief: WiFi and Bluetooth RF Systems	lecture notes and courseware
2	Maxwell's Equations in Phasor Form; Complex Constitutive Parameters; Microwave Power and Energy Tech. Brief: Complex Permittivity of Human Tissue	same
3	Principle of Radiation; Polarization	

	Tech Brief: Microwave Field Interaction with the Human Body	
4	TEM and Quasi-TEM Transmission Lines, PUL Parameters, Voltage & Current Waves Tech. Brief: Microstrip Technology	same
5	Terminated Transmission Lines; The Smith Chart and Basic Impedance-Matching Methods Tech. Brief: Baluns	same
6	Scattering Parameters and Signal Flow Graphs Tech. Brief: The Vector Network Analyzer	same
7	1-port and 2-port Passive High-frequency Components: Capacitors, Inductors, Terminations, Attenuators Tech. Brief: Microwave Filters	same
8	3-port and 4-port Passives: Power Dividers, Directional Couplers and Hybrids Tech. Brief: Circulators	same
9	Microwave Waveguides Tech. Brief: Waveguide Couplers	same
10	Active High-frequency Components: Schottky, PIN and Gunn Diodes; High-frequency Transistors Tech. Brief: Low-noise Amplifiers	same
11	The Dipole Antenna; Antenna Characteristics Tech. Brief: Anechoic Chambers	same
12	Propagation Models: Friis Equation; System Noise; Receiver Sensitivity Tech. Brief: Link Budget and Link Margin	same
13	Printed Antennas; Cell-phone, Bluetooth and WiFi Antennas	same

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 A2L course website).

Course Overview

McMaster UG Calendar:

This course provides the fundamentals of the technology of wireless communications. transmission lines and waveguides, scattering parameters, impedance matching, power dividers, directional couplers, microwave resonators and filters, microwave sources and active devices, antenna fundamentals, microwave and antenna measurements.

Three lectures, one tutorial, one lab every other week; first term

Instructor:

Fundamentals of the technology of wireless communications: transmission lines and waveguides, scattering parameters, impedance matching, power dividers, directional couplers, microwave resonators and filters, antenna fundamentals, microwave and antenna measurements.

Laboratory Overview

Modules	Topic	Readings
1	Introduction to Scattering Parameters and Vector Network Analyzers (VNAs): 1-Port Calibration, Instrument Noise Floor, and Measurements of 1-Port Devices	Lab Workbook 1
2	VNA 2-Port Calibration, Instrument Noise Floor, and Measurements of 2-port Devices	Lab Workbook 2
3	VNA Measurements of Multi-port Passive Devices	Lab Workbook 3
4	Antenna Measurements with a VNA	Lab Workbook 4
5	Wireless Link: Effects of distance, antenna gain,	Lab Workbook 5

polarization mismatch and presence of obstacle on signal strength

Laboratory Operation

- Each student in the course is required to pass the lab safety quiz prior to attempting any of the laboratories. The quiz will be available on Avenue to Learn.
- Access to all labs is restricted in the interest of security and safety. Information on accessing and using the lab can be found on this webpage:
<https://www.eng.mcmaster.ca/ece/labs-and-health-safety#Labs-Access-and-Use>
- Minimum Lab Mark: Overall Lab Mark below 50% leads to failure of the course.
- Lab Experiments: Every student conducts the lab experiment during her/his lab section time slot.
- Lab Requirements: Students need to submit their Lab Reports on Avenue to Learn and notify the TA about their submission. Feedback and a mark will be provided within one week of the submission. The A2L Lab Report Dropboxes will remain open until the end of classes (Dec. 6, 2023 11:59 pm).

Course Evaluation

<u>Component</u>	<u>Weight</u>	<u>Notes</u>
Design Project	10%	1 project
Assignments	25%	8 modules, assignment mark averaged over all 8 marks
Laboratory	20%	5 modules, lab mark averaged over all 5 marks
Quizzes	10%	About 10 quizzes, quiz mark averaged over all marks
Midterm Exam	15%	1 midterm test
Final Exam	20%	1 final exam
Total	100%	

Course Evaluation Details

BONUS Components (optional):

- ASSIGNMENT 3 BONUS (Mixer Design) (3% toward final course grade)
- HI-SCI BONUS (3 theoretical problem sets) (5% toward final course grade)

QUIZ NOTES: Quizzes will be posted and announced at the end of a lecture. A quiz answer must be submitted by the end of the day (11:59 pm) of the announcement through the respective Dropbox on A2L.

GRADING AND EVALUATION POLICIES

- If ALL three marks for final exam, midterm test and quizzes, are below 50% (mark out of 100%), the overall course grade is fail (F). Example A: Final Exam Mark 45%, Midterm Test Mark 40%, Quiz Mark 45% → Course Grade F. Example B: Final Exam Mark 45%, Midterm Test Mark 40%, Quiz Mark 55% → Course Grade determined according to the weighting scheme in the Table above, provided Lab Mark exceeds 50%.
- Midterm test and final exam papers can be viewed in person (after marking is completed) during the Instructor's Office Hours.
- If the Lab Mark is below 50%, the overall course grade is fail (F).
- Deferred exams may be oral.
- All grades are final unless error in marking is proven.
- Marking scheme is flexible only if the final-exam mark $\geq 89\%$.
- Late submissions of assignments are subject to 50% penalty per day (less than one day is counted as one day)
- No make-up midterm tests will be granted.
- Weight of missed midterm test will be transferred to final exam provided MSAF is filed. If MSAF is not filed, the midterm test mark is 0.
- Weight of missed quizzes will be transferred to the weight of the rest of the quizzes, provided MSAF is filed. If MSAF is not filed, the quiz mark is 0.
- Weight of missed assignments will be transferred to the weight of the rest of the assignments, provided MSAF is filed. If MSAF is not filed, the assignment mark is 0.

Grading Scale

The McMaster 12 Point Grading Scale

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49

Late Assignments

- Late submissions of assignments are subject to 50% penalty per day (less than one day is counted as one day).

Absences, Missed Work, Illness

- No make-up midterm tests will be granted.
- Weight of missed midterm test will be transferred to final exam provided MSAF is filed. If MSAF is not filed, the midterm test mark is 0.
- Weight of missed quizzes will be transferred to the weight of the rest of the quizzes, provided MSAF is filed. If MSAF is not filed, the quiz mark is 0.

- Weight of missed assignments will be transferred to the weight of the rest of the assignments, provided MSAF is filed. If MSAF is not filed, the assignment mark is 0.

Turnitin.com

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Course Modification

No major modifications are expected.

Generative AI: Use Prohibited

Students are not permitted to use generative AI in this course. In alignment with [McMaster academic integrity policy](#), it “shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source”. This includes work created by generative AI tools. Also state in the policy is the following, “Contract Cheating is the act of “outsourcing of student work to third parties” (Lancaster & Clarke, 2016, p. 639) with or without payment.” Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

APPROVED ADVISORY STATEMENTS

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. **It is your responsibility to understand what constitutes academic dishonesty.**

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. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/), located at <https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/>

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.

Courses with an On-line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, 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 a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster 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.

Equity, Diversity, and Inclusion

The Faculty of Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Faculty, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office.

Academic Accommodation 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 Advising

For any academic inquires please reach out to the Office of the Associate Dean (Academic) in Engineering located in JHE-Hatch 301.

Details on academic supports and contact information are available from:

<https://www.eng.mcmaster.ca/programs/academic-advising>

Requests for Relief for Missed Academic Term Work

In the event of an absence for medical or other reasons, students should review and follow the Policy on Requests for Relief for Missed Academic Term Work.

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.

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.

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, Avenue to Learn and/or McMaster email.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

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 and online: <https://hr.mcmaster.ca/app/uploads/2019/07/2019-McMaster-Lab-Manual.pdf>

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following whether conducting lab work at school or at home:

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.
9. Personal ergonomics should be practiced when conducting lab work.
<https://bit.ly/3fOE71E>
10. Current University health and safety issues, and protocols should be known.
<https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/>

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.

In Case of a Fire (On Campus 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 non-flammable 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 labs, 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

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	spencers@mcmaster.ca
ECE Chair	Mohamed Bakr- ITB A111	mbakr@mcmaster.ca
ECE Administrator	Shelby Gaudrault- ITB A111/B	gaudraus@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	