

Course Outline (F2025)

ELE531: Electromagnetics

Instructor(s)	MD Shazzat Hossain [Coordinator] Office: ENG478M Phone: TBA Email: mdshazzat.hossain@torontomu.ca Office Hours: Fridays, 11- 12 pm (online)
Calendar Description	Time-varying fields and Maxwell's equations, boundary conditions, retarded potentials. The wave equation. The uniform plane wave, wave polarization, wave reflection. Transmission lines, Smith chart. Rectangular waveguides. Radiation from short dipoles, half- and quarter-wavelength antennas, the radiation resistance. Basic microwave measurements.
Prerequisites	ELE 401 and CEN 199
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	<ol style="list-style-type: none"> 1. M.N.O. Sadiku, Elements of Electromagnetics, 7th edition, Oxford University Press, 2018. (available at TMU Library) 2. F.T. Ulaby and U. Ravaioli, Fundamentals of Applied Electromagnetics, 8th edition, Pearson Education, 2020.(available at TMU Library) 3. Microwave Fundamentals, Student Manual, Festo Lab-Volt series (Quebec) Ltd., 1998 (2008 or later printing). (available at d2L course shell)
Reference Text(s):	<ol style="list-style-type: none"> 1. W.H. Hayt, Engineering Electromagnetics, 8th ed, McGraw-Hill, 2012. 2. D.K. Cheng, Fundamentals of Engineering Electromagnetics, Addison-Wesley, 1993. 3. R.E. Collin, Field Theory of Guided Waves, 2nd edition, IEEE Press, 1991. 4. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd edition, Prentice-Hall, 1968. 5. J.A. Edminister, Theory and Problems of Electromagnetics, 2nd edition, Schaum's Outline Series, McGraw- Hill, 1993.

<p>Learning Objectives (Indicators)</p>	<p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> 1. Develops further knowledge of science in support of application to engineering problems. (1a) 2. Applies mathematical principles, skills, and tools to solve engineering problems, highlighting limitations or a range of applications. (1b) 3. Demonstrates and applies core engineering principles and concepts to solve engineering problems. (1c) 4. Develops further knowledge of uses of modern instrumentation, data collection techniques, and equipment to conduct experiments and obtain valid data. (5a) <p>NOTE: Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p>																
<p>Course Organization</p>	<p>3.0 hours of lecture per week for 13 weeks 1.0 hours of lab per week for 12 weeks 1.0 hours of tutorial per week for 12 weeks</p>																
<p>Teaching Assistants</p>	<p>Protik Mukherjee; email: protik.mukherjee@torontomu.ca Samiul Islam; email: s10islam@torontomu.ca Snikdho Sworov Haque; email: snikdho.haque@torontomu.ca</p>																
<p>Course Evaluation</p>	<table border="1" data-bbox="427 898 1352 1367"> <thead> <tr> <th colspan="2" style="text-align: left;">Theory</th> </tr> </thead> <tbody> <tr> <td>Midterm test</td> <td style="text-align: right;">30 %</td> </tr> <tr> <td>Lab Exam</td> <td style="text-align: right;">7 %</td> </tr> <tr> <td>Final Exam</td> <td style="text-align: right;">40 %</td> </tr> <tr> <td>Quiz</td> <td style="text-align: right;">10 %</td> </tr> <tr> <th colspan="2" style="text-align: left;">Laboratory</th> </tr> <tr> <td>Labs</td> <td style="text-align: right;">13 %</td> </tr> <tr> <td>TOTAL:</td> <td style="text-align: right;">100 %</td> </tr> </tbody> </table> <p>Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p>	Theory		Midterm test	30 %	Lab Exam	7 %	Final Exam	40 %	Quiz	10 %	Laboratory		Labs	13 %	TOTAL:	100 %
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<p>Examinations</p>	<p>The duration of the midterm test is 2 hours. It is a closed-book test. It covers lecture materials up to the week preceding the midterm test. The final exam, which includes a written lab exam, is 3 hours. It is a closed-book exam. The final exam is designed to comprehensively cover the course material.</p>																
<p>Other Evaluation Information</p>	<p>To achieve a passing grade, student must pass both the theory and laboratory/project components.</p>																

Teaching Methods	Lectures: Wednesdays, 9-12 pm, DSQ23
Other Information	None

Course Content

Week	Hours	Chapters / Section	Topic, description
1-2	6	d2L& Ch 9	Time-Varying Fields and Maxwell's Equations 1.1 Electromagnetostatic Field (Review) <ul style="list-style-type: none"> - Coulomb's law and Gauss's Law - The Electric potential - Poisson's and Laplace's Equations - Biot-Savart's Law and Ampere's Circuital Law - Magnetic Vector Potential and Vector Poisson's Equation - Time invariant Maxwell's Equations 1.2 Faraday's Law (Review) 1.3 The Displacement Current (Review) 1.4 Maxwell's Equations in Point Form 1.5 Maxwell's Equations in Integral Form 1.6 Maxwell's Equations in the Frequency Domain 1.7 Boundary Conditions for time-varying fields 1.8 Retarded Potentials
3-6	12	Ch 10	The Uniform Plane Wave 2.1 The Wave Equation 2.2 Plane Waves in Perfect Dielectrics 2.3 Plane Waves in Lossy Dielectrics 2.4 Poynting Vector 2.5 Plane Waves in Good Conductors (Skin Effect) 2.6 Reflections of Plane Waves at Interfaces 2.7 Standing Wave Ratio (SWR) and Input Impedance
7-9	12	Ch 11 (sec1-6)	Transmission Lines 3.1 Transmission-Line Equations 3.2 Input Impedance SWR and Power 3.3 The Smith Chart 3.4 Some Applications of Transmission Lines
10-11	6	Ch 12 (12.1-12.5)	Waveguides 4.1 Rectangular Waveguides 4.2 Transverse Magnetic (TM) Modes 4.3 Transverse Electric (TE) Modes 4.4 Wave Propagation in the Guide

12	3	Ch 13 (13.1-13.4)	Antennas and Radiation 5.1 Radiation from Infinitesimal Current Elements 5.2 The Half-Wave Dipole Antenna 5.3 The Quarter-Wave Monopole Antenna
13	3		Catching up and Review

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
---	---	Basic Microwave Measurements 1-hour Lab every week, Tutorial 1-hour every hour
2	Lab 1/Tutorial 1	Familiarization with Microwave Equipment. Tutorial problem set #1
3	Lab 2/ Tutorial 2	Microwave Power Measurement. Tutorial problem set #2
4	Lab 3/Tutorial#3	Calibration of Variable Attenuators. Tutorial problem set #3
5	Lab 4/Quiz#1	Unknown Attenuation Measurement. Quiz#1
6	Lab 5/Tutorial 4	Standing Waves for Short Circuit Condition. Tutorial problem set #4
7	Lab 6/Quiz#2	Standing Waves for Load Condition and Matched Load Condition Quiz#2
8	Tutorial 5	Midterm Week (No Labs, only Tutorials) Tutorial problem set#5
9	Lab7/Tutorial 6	Directional Coupler Calibration. Tutorial problem set#6

10	Lab8/Quiz#3	Reflection Coefficient Measurement. Quiz#3
11	Lab9/Tutorial 7	SWR Measurement. Tutorial problem set#7
12	Lab10/Quiz#4	Unknown Impedance Measurement. Quiz#4
13	Tutorial 8	Makeup and Lab Evaluation Tutorial problem set#8

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Refer to the [Departmental FAQ page](#) for further information on common questions.

Important Resources Available at Toronto Metropolitan University

- [The University Libraries](#) provide research [workshops](#) and individual consultation appointments. There is a drop-in Research Help desk on the second floor of the library, and students can use the [Library's virtual research help service](#) to speak with a librarian, or [book an appointment](#) to meet in person or online.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: Academic Consideration Request (ACR) to submit this request.

For Extenuating Circumstances, [Policy 167: Academic Consideration](#) allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, always require documentation. Students must notify their faculty/contract lecturer once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

Longer absences are not addressed through Policy 167 and should be discussed with your Chair/Director/Program to be advised on next steps.

- [FAQs Academic Considerations and Appeals](#)
- Information on Copyright for [Faculty/Contract Lecturers](#) and [students](#).

Lab Safety (if applicable)

Students are to strictly adhere and follow:

- a. The Lab Safety information/guidelines posted in the respective labs,
- b. provided in their respective lab handouts, and
- c. instructions provided by the Teaching Assistants/Course instructors/Technical Staff.

During the lab sessions, to avoid tripping hazards, the area around the lab stations should not be surrounded by bags, backpacks etc, students should place their bags, backpacks etc against the walls of the labs and/or away from their lab stations in such a way that it avoids tripping hazards.

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).
- Learn about [Policy 159: Academic Accommodation of Students with Disabilities](#)

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.