Toronto Metropolitan University

Course Outline (F2025)

MTE501: Signals and Systems for Mechatronics Eng

Instructor(s)	Dr. Mohammed Saif [Coordinator] Office: EPH417 Phone: TBA Email: mohammed.saif@torontomu.ca Office Hours: Friday 11:00 am- 12:00 pm
Calendar Description	This course deals with the analysis of continuous-time and discrete-time signals and systems. Topics include: representations of linear time-invariant (LTI) systems, representations of signals, transfer function, impulse response, system response, the convolution integral and its interpretation; Fourier analysis for continuous-time and discrete-time signals and systems, analysis and synthesis, frequency domain analysis, sampling, Laplace transform, Z-transform.
Prerequisites	CEN 199, MTH 425, MTE 401, MTE 301
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. B.P. Lathi, Linear Systems and Signals, 3rd edition, Oxford University Press, 2018. $202.84 CAD
Reference Text(s):	1. M. J. Roberts, Signals and Systems, 2nd edition, McGraw Hill, 2011.
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. Formulates mathematical models for the signals using scientific and engineering principles. Justifies model assumptions and understands model limitations. Evaluates the effect of uncertainty in model parameters and errors in numerical method. (**2b**) 2. Learn important signal and system classifications for further processing. For example, if a system is Linear and Time Invariant, then output of the system to all inputs can be predicted using the impulse response and using convolution. (**3a**) 3. Learn frequency analysis of signals and LTI systems and describe differences between Fourier transform and Fourier series analysis. Perform both Fourier transform and Fourier series in hypothetical design and analysis of signals and LTI systems. Analyze result of evaluation to detect if a system is Linear Time-Invariant (LTI). To discern additional criteria. In case the system is LTI, additional characteristic of the system (impulse response of the system) is calculated to facilitate calculation and evaluation of the system's output. (**4b**) 4. Select and perform strategies to generate information about signals (properties such as power or energy) and systems (properties such as linearity, stability, causality) that may be used to modify, improve, or elaborate a design state. (**4c**) 5. Understanding system property and limitation, fundamental problems in sampling. Learning the role of important signals such as the sinc and delta and role of them in system design and analysis. (**5a**)

6. Read and appropriately respond to technical and non-technical written instructions. Cites evidence to construct and support an argument. Produce four lab reports using appropriate format, grammar, and citation styles for technical and non-technical audiences. (**7a**)
7. Illustrate concepts of signals and systems through graphical presentation of their properties. (**7c**)
8. Finding relationship between signals, building a signal based on other existing basis, signal modulation and its practical issues that can be well explained with the theory. (**12a**)

NOTE:*Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*

Course Organization

4.0 hours of lecture per week for 13 weeks
2.0 hours of lab per week for 12 weeks
0.0 hours of tutorial per week for 12 weeks

Teaching Assistants

1- Romina Arabi
email: romina.arabi@torontomu.ca

2- Osama Harmouche
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Course Evaluation

Theory	
Quizzes (4x3.75%)	15 %
Midterm Exam	25 %
Final Exam	40 %
Laboratory	
Lab assignments (8x2.5%)	20 %
TOTAL:	100 %

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).

Examinations

* Quizzes are scheduled on Week 4, 6, 9 and 11, approximately 20-30 minutes, during the lab hours.

* Midterm exam is scheduled on 24-10-2025 during lecture time. It will be problem-solving, closed book (Formula sheet provided).

* Final exam, during exam period, approximately 3 hours, and closed book (Formula sheet provided).

Other Evaluation Information

Practice Problems/Assignments: Assignment problems and solutions will be provided on D2L. The assignments will neither be collected nor graded; they are provided only as a study guide.You are strongly recommended to attempt to solve the problems on your own without looking at the solutions first. If you have any questions about an assignment problem or its solution, please consult the course instructor or the teaching assistant during their consulting hours.

Students will have the responsibility to achieve a working knowledge of the software packages

	that will be used in the lab. Except where requests for Academic Consideration are granted, late submissions will be penalized at a rate of 10% per day, where weekends count as 2 days for online submissions, and as 0 days for hardcopy submissions. Reassessment/Re-Grading All requests for reassessment/regrading of submitted work must be made in writing (via email) to either the teaching assistants (for lab and midterm exam grades and CC the instructor) or the instructor (for final exam grades) and must follow the procedures specified in TMU Policy 162.
Teaching Methods	In class, in person lectures only. The lectures will include a mix of theoretical content and problem solving.
Other Information	All lecture notes will be posted on D2L.

Course Content

Week	Hours	Chapters / Section	Topic, description
1	4	-Chp 1 Sec 1-7	Signals and Systems Representations
2, 3	4	-Chp 2 Sec 1-6	Time-Domain Analysis of Continuous-Time Systems * Signals, system properties, system response, convolution
4	4	-Chp 6 Sec 1-3	Continuous-Time Signal Analysis: The Fourier Series
5, 6	8	-Chp 7 Sec 1-3	Continuous-Time Signal Analysis: The Fourier Transform * Analysis and synthesis * Properties of Fourier Transform
6, 7	8	-Chp 4 Sec 4.1, 4.2, Sec 4.4-4.6	The Laplace transform * Bilateral and unilateral Laplace transform * Properties of the Laplace transform
8	4	-Chp 8	Introduction to Sampling theorem signal reconstruction * Nyquist rate and aliasing

9, 10	8	-Chp 3	Discrete-Domain Analysis of Discrete-Time Systems * Signals, system properties, system response, convolution
11	4	-Chp 9	Discrete-Time Signal Analysis: The Fourier Series
12	4	-Chp 9	Discrete-Time Signal Analysis: The Fourier Transform
13	4	-Chp 5	Z-Transform

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

Week	L/T/A	Description
2	L	Lab 1: Signals and Signals Properties Objective: Writing simple Python functions to represent signals and visualize the effects of their operations.
3 & 4	L/T	Lab 2: System Properties and Convolution Objective: Using Python to exercise convolution and investigate system properties.
5	L	Lab 3: Fourier Series Analysis The objective of this experiment is to investigate the Fourier Series while continuing to learn how to use Python effectively.
6 & 7	L/T	Lab 4: The Fourier Transform In this experiment you will investigate properties of the Fourier transform. You will use Fourier Transform to analyze dual-tone multi frequency (DTMF) signals used in telephone signalling.
8	T	Tutorial: Problem-solving for the midterm
9	L	Lab 5: Time-Domain Analysis of Discrete-Time Systems (part 1) In this first assignment, you will learn about concepts of discrete-time signals, apply a different transformation to discrete signals, and plot the signals and systems using Python.

10	L	Lab 6: Time-Domain Analysis of Discrete-Time Systems (part 2) In this lab, you will use Python to determine unit impulse response, zero state response and total response for systems.
11	L	Lab 7: Discrete-Time Fourier Series In Lab 7, you will learn about the Discrete-Time Fourier Series (DTFS). You will implement the DTFS and the Inverse Discrete-Time Fourier Series (IDTFS) using Python. You also will examine some properties of DTFS.
12	L	Lab 8: Discrete-Time Fourier Transform In this assignment you will learn about the Discrete-Time Fourier transform (DTFT). You will learn how to use the FFT to calculate the DTFT of a signal and examine the time convolution property of DTFT.

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 furhter 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.