

**Course Outline (F2023)**

**ELE504: Electronic Circuits II**

<b>Instructor(s)</b>	Dr. Mike Kassam [Coordinator] Office: ENG470 Phone: (416) 979-5000 x 556103 Email: mkassam@torontomu.ca Office Hours: Refer to Course Webpage (D2L)
<b>Calendar Description</b>	Advanced course on the analysis and design of electronic circuits. Topics include non-ideal Op-Amp amplifier characteristics, practical amplifier designs, linear/non-linear Op-Amp circuits, filters and tuned amplifiers, oscillators, signal generators, power output stages, etc. Circuit applications to such areas as instrumentation, signal processing and conditioning, and control are considered. Key design concepts are experienced through laboratory work and a major design project, use of electronic circuit simulation tools, and solving design problems.
<b>Prerequisites</b>	ELE 404 and CEN 199
<b>Antirequisites</b>	None
<b>Corerequisites</b>	None
<b>Compulsory Text(s):</b>	1. Microelectronic Circuits, Sedra and Smith, 6th, 7th or 8th edition, Oxford University Press. (Same textbook as was required for ELE404 course)
<b>Reference Text(s):</b>	1. Operational Amplifiers with Linear Integrated Circuits, 4th edition, Stanley, Prentice- Hall. 2. Basic Operational Amplifier and Linear Integrated Circuits, Floyd and Buchla, 2nd Edition.
<b>Learning Objectives (Indicators)</b>	<p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> <li>1. Analyze, design and implement use of Op-Amp based linear/non-linear electronic circuits to solve engineering problems. Understand, and effectively use, engineering principles and theories to formulate design problems (issues) based on the required specifications and/or functionalities. <b>(4a), (4b)</b></li> <li>2. Use analysis, modeling and design simulation/development tools to seek, and decide on, optimal design solution(s). <b>(4c)</b></li> <li>3. Use of engineering tool (MultiSim Electronics Circuit Simulator) to allow verification of design/problem analysis through use of real devices and simulation models. <b>(5a)</b></li> <li>4. Demonstrate the main design features of the Major-Project and answer critical and project specific questions during project demo and oral sessions. Write a formal technical report (following the prescribed template and guidelines) reflecting the design process used for the Major Project (MP), where all the reports are evaluated based on their completeness, technical content and proper use of the English language. <b>(7a)</b></li> </ol> <p><b>NOTE:</b> Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p>

<b>Course Organization</b>	3.0 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																										
<b>Teaching Assistants</b>	Teaching Assistant (TA) for each lab section will be listed on D2L course webpage.																										
<b>Course Evaluation</b>	<table border="1" data-bbox="428 380 1354 1142"> <thead> <tr> <th colspan="2" data-bbox="428 380 1354 443"><b>Theory</b></th> </tr> </thead> <tbody> <tr> <td data-bbox="428 443 1170 499">Midterm Exam</td> <td data-bbox="1170 443 1354 499">25 %</td> </tr> <tr> <td data-bbox="428 499 1170 556">Final Exam</td> <td data-bbox="1170 499 1354 556">40 %</td> </tr> <tr> <th colspan="2" data-bbox="428 556 1354 619"><b>Laboratory</b></th> </tr> <tr> <td data-bbox="428 619 1170 676">Lab 1</td> <td data-bbox="1170 619 1354 676">3 %</td> </tr> <tr> <td data-bbox="428 676 1170 732">Lab 2</td> <td data-bbox="1170 676 1354 732">3 %</td> </tr> <tr> <td data-bbox="428 732 1170 789">Lab 3</td> <td data-bbox="1170 732 1354 789">3 %</td> </tr> <tr> <td data-bbox="428 789 1170 846">Major Project (MP)</td> <td data-bbox="1170 789 1354 846">14 %</td> </tr> <tr> <td data-bbox="428 846 1170 903">Lab 4</td> <td data-bbox="1170 846 1354 903">3 %</td> </tr> <tr> <td data-bbox="428 903 1170 959">Lab 5</td> <td data-bbox="1170 903 1354 959">3 %</td> </tr> <tr> <td data-bbox="428 959 1170 1016">Lab 6</td> <td data-bbox="1170 959 1354 1016">3 %</td> </tr> <tr> <td data-bbox="428 1016 1170 1073">Lab 7</td> <td data-bbox="1170 1016 1354 1073">3 %</td> </tr> <tr> <td data-bbox="428 1073 1170 1142">TOTAL:</td> <td data-bbox="1170 1073 1354 1142">100 %</td> </tr> </tbody> </table> <p data-bbox="310 1199 1463 1377"><b>Note:</b> 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 "<b>Theory and Laboratory</b>" 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 "<b>Course Evaluation</b>" section above for details on the Theory and Laboratory components (if applicable).</p>	<b>Theory</b>		Midterm Exam	25 %	Final Exam	40 %	<b>Laboratory</b>		Lab 1	3 %	Lab 2	3 %	Lab 3	3 %	Major Project (MP)	14 %	Lab 4	3 %	Lab 5	3 %	Lab 6	3 %	Lab 7	3 %	TOTAL:	100 %
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<b>Examinations</b>	Midterm Exam in Week 7 during class hours for 1hr:50min., closed book (covers course materials in Weeks 1 to 6/7). Final Exam, 3hrs duration, closed-book (covers course materials from Weeks 1 to 13).																										
<b>Other Evaluation Information</b>	<p data-bbox="310 1610 1438 1698">Midterm Exam:- A single Midterm Exam will be held. No make-up exam will be provided for missing the Midterm Exam for a valid reason, instead its weight will be shifted to the Final Exam for eligible cases.</p> <p data-bbox="310 1730 1471 1877">Labs &amp; Major Project(MP):- The Pre-Lab (Analysis &amp; Simulations) for each lab and Major Project Milestones are to be done INDIVIDUALLY and submitted by each student via D2L, whereas the In-Lab work will be done in LAB GROUPS of up to 2 students per Lab Group and the weekly Lab Report is to be done and submitted as a GROUP. The specific deliverables and Lab/MP marking schemes are provided in each Lab/MP description available on the ELE504 course website (D2L).</p> <p data-bbox="310 1908 1450 1997">Missed In-Lab Work:- A student who misses any scheduled In-Lab work for a valid reason (per Policy 167) will be given a make-up opportunity to complete the missed In-Lab work on their own based on the student's own Pre-Lab assignment, and followed with the required Lab Report</p>																										

	submission by the student. The make-up lab schedule will be arranged by the Instructor on a case by case basis.
<b>Teaching Methods</b>	The lecture and labs will be 100% in-person. Past lecture notes will be made available on D2L.
<b>Other Information</b>	<p>(1) LAB KIT: ELE504 lab kit should be purchased individually, and not per lab group. Most of the Labs/MP will require some components from your previous ELE404 Kit to supplement the ELE504 Kit. labs/MP. It is each student's responsibility to have all required circuit components available prior to the start of each lab.</p> <p>(2) MULTISIM: Students are required to ONLY use the Department's licensed V14.2 version (or the most recent version) of the MultiSIM Simulator. Zero mark will be awarded for the Lab/MP submission that uses either an incorrect version, or the on-line freeware version, of MultiSIM. Download instructions are posted on the ELE504 course website (D2L). There is no charge to the student for use of this licensed version of MultiSIM.</p>

## Course Content

Week	Hours	Chapters / Section	Topic, description
1 - 3	8		Chapter 2: Operational Amplifiers (Op-Amp) Ideal Op-Amp and Applications review (Section 2.1-2.3) Difference Amplifiers (Section 2.4) Non-Ideal Op-Amp (Sections 2.6-2.8) - DC imperfections - Finite open-loop gains and bandwidths - Large signal operations Integrators and Differentiators (Section 2.5) Practical Applications (notes)
3-7	10		Chapters 4 and 18: Waveform Shaping Circuits Section 18.4: Bistable Multivibrators Section 18.5: Square and Triangular waveform generations Section 4.5: Basic Rectifier and Superdiode Notes: Precision Rectifier Circuits Sections 18.6-7: Pulse Generation and Integrated-Circuit Timers Notes: Practical Applications
7	2		Midterm Exam
8-10	8		Chapter 18: Signal Generation Section 18.1: Oscillation principles Section 18.2: Op-amp-RC Oscillators Section 18.3: LC and Crystal Oscillators Notes: Practical Applications

10-13	7	Chapter 17: Active Filters Section 17.1-2: Filter Concepts Section 17.3: Notes: Butterworth and Chebyshev Filters Section 17.4: Notes: Filter Design Implementation using second order Sallen Key Circuits Section 17.9: Sensitivity analysis
12-13	2	Suppl. Notes: Single-Supply Op-Amps Circuit Design Techniques
13	2	Chapter 11: Power Output Stages for Op-Amp Amplifiers Section 11.1: Class A Section 11.3: Class B Section 11.4: and notes Class AB

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

Week	L/T/A	Description
1	---	No Lab Scheduled. Each lab group should purchase the ELE504 Lab KIT before the next lab. Refer to D2L.
2	In-Person	L1: Select Op-Amp Circuits (Review)
3	In-Person	L2: Part I - Non-ideal Op-Amp Characteristics
4	In-Person	L3: Part II - Practical Audio Amplifier Design
5-9	In-Person	MP (Major Project): Design of Voltage Controlled Frequency Generator (VCFG)
10	In-Person	L4: Precision Rectifier Circuits
11	In-Person	L5: Part I - 555 Timer Circuits - Monostable & Astable Applications

12	In-Person	L6: Part II - Oscillator Circuits
13	In-Person	L7: Active Filter Designs

## University Policies

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](#)

## Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [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, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).*

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

## 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](#).

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](mailto:csdc@torontomu.ca)
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email [osvse@torontomu.ca](mailto: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.