## Course Outline (F2023)

### ELE504: Electronic Circuits II

**Instructor(s)**
- Dr. Mike Kassam [Coordinator]
- Office: ENG470
- Phone: (416) 979-5000 x 556103
- Email: mkassam@torontomu.ca
- Office Hours: Refer to Course Webpage (D2L)

### Calendar Description

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.

### Prerequisites

- ELE 404 and CEN 199

### Antirequisites

- None

### Corequisites

- None

### Compulsory Text(s):

1. Microelectronic Circuits, Sedra and Smith, 6th, 7th or 8th edition, Oxford University Press. (Same textbook as was required for ELE404 course)

### Reference Text(s):


### Learning Objectives (Indicators)

At the end of this course, the successful student will be able to:

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. (4a), (4b)
2. Use analysis, modeling and design simulation/development tools to seek, and decide on, optimal design solution(s). (4c)
3. Use of engineering tool (MultiSim Electronics Circuit Simulator) to allow verification of design/problem analysis through use of real devices’ simulation models. (5a)
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. (7a)

**NOTE:** Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).
| Course Organization | 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 |
| Teaching Assistants | Teaching Assistant (TA) for each lab section will be listed on D2L course webpage. |
| Course Evaluation   | **Theory**  
|                     | Midterm Exam  25 %  
|                     | Final Exam  40 %  
|                     | **Laboratory**  
|                     | 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 %  

**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 | 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). |
| Other Evaluation Information | 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.  
|                     | Labs & Major Project(MP):- The Pre-Lab (Analysis & 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).  
|                     | 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 |
submission by the student. The make-up lab schedule will be arranged by the Instructor on a case-by-case basis.

Teaching Methods
The lecture and labs will be 100% in-person. Past lecture notes will be made available on D2L.

Other Information
(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 Labs/MP. It is each student’s responsibility to have all required circuit components available prior to the start of each lab.

(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.

Course Content

<table>
<thead>
<tr>
<th>Week</th>
<th>Hours</th>
<th>Chapters / Section</th>
<th>Topic, description</th>
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</thead>
</table>
| 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 |
### 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

### Suppl. Notes: Single-Supply Op-Amps Circuit Design Techniques

### 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

<table>
<thead>
<tr>
<th>Week</th>
<th>L/T/A</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>---</td>
<td>No Lab Scheduled. Each lab group should purchase the ELE504 Lab KIT before the next lab. Refer to D2L.</td>
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<tr>
<td>2</td>
<td>In-Person</td>
<td>L1: Select Op-Amp Circuits (Review)</td>
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<tr>
<td>3</td>
<td>In-Person</td>
<td>L2: Part I - Non-ideal Op-Amp Characteristics</td>
</tr>
<tr>
<td>4</td>
<td>In-Person</td>
<td>L3: Part II - Practical Audio Amplifier Design</td>
</tr>
<tr>
<td>5-9</td>
<td>In-Person</td>
<td>MP (Major Project): Design of Voltage Controlled Frequency Generator (VCFG)</td>
</tr>
<tr>
<td>10</td>
<td>In-Person</td>
<td>L4: Precision Rectifier Circuits</td>
</tr>
<tr>
<td>11</td>
<td>In-Person</td>
<td>L5: Part I - 555 Timer Circuits - Monostable &amp; Astable Applications</td>
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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, 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
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osyse@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.