

Instructor: Ehsan Ghias-Begloo
EhsanGhiasBegloo@cunet.carleton.ca
Office Hours: MS Teams, by appointment

Website: Course materials and information will be posted on its Brightspace section. It will be the primary means for announcements. Students must check it regularly.

Lectures: Wednesdays and Thursday 8:35 – 9:55 am; CB 3101

Course Description: Basic principles of Computer-Aided Design tools used for analysis and design of VLSI circuits and systems. Automated formulation of circuit equations, Frequency, DC and time-domain analysis. Noise and distortion analysis. Interconnect analysis. Sensitivity analysis, and circuit performance optimization.

Prerequisite(s): Enrolment in the Master of Engineering Practice program.

Learning Outcomes: By the end of the course, students will be able to:

1. Analyze the physical principles underlying device operation and apply this understanding to model analog circuit behavior accurately.
2. Employ analytical methods to evaluate and predict the performance of essential analog circuit elements and configurations.
3. Utilize simulation tools to execute circuit-level analyses, including noise and sensitivity studies, to identify performance limitations and non-ideal effects.
4. Develop and refine analog circuit designs that address key performance metrics such as stability, linearity, and noise immunity through iterative optimization.
5. Integrate foundational theory and computational results to critically assess design decisions and propose effective circuit solutions under realistic constraints.

Textbook(s)/Learning Materials: Students are not required to purchase textbooks or other learning materials for this course.

Topics and Tentative Plan:

Week	Anticipated Topic*	Important Dates*
1 (1 Sep.)	<ul style="list-style-type: none"> • Introduction and objectives • Device physics 	
2 (8 Sep.)	<ul style="list-style-type: none"> • MOSFET Operation 	
3 (15 Sep.)	<ul style="list-style-type: none"> • Capacitors 	
4 (22 Sep.)	<ul style="list-style-type: none"> • Large signal analysis 	
5 (29 Sep.)	<ul style="list-style-type: none"> • Voltage references 	
6 (6 Oct.)	<ul style="list-style-type: none"> • Small signal analysis 	Lab 1 due 8 Oct.
7 (13 Oct.)	<ul style="list-style-type: none"> • Inverting amplifiers 	
8 (20 Oct.)	Fall break – No class	
9 (27 Oct.)	<ul style="list-style-type: none"> • Differential amplifiers 	Lab 2 due 29 Oct.
10 (3 Nov.)	<ul style="list-style-type: none"> • Switched capacitor filters 	
11 (10 Nov.)	<ul style="list-style-type: none"> • Op. amps 	Lab 3 due 12 Nov.
12 (17 Nov.)	<ul style="list-style-type: none"> • Cont. Op. amps 	
13 (24 Nov.)	<ul style="list-style-type: none"> • Noise analysis • Circuit sensitivity 	Lab 4 due 26 Nov.
14 (1 Dec.)	<ul style="list-style-type: none"> • Review 	Lab 5 due Dec 3.

* Subject to change. I reserve the right to revise as the course progresses.

Evaluation and Marking Scheme:

- In Class Quizzes: 35%
- Labs: 40%
- Take-Home Exam: 25%

- **In-Class Quizzes:** Short, closed-book quizzes will be administered during each class session, time permitting, except on days with scheduled activities or when notified in advance. There are no makeup quizzes, and any missed quizzes will result in a loss of marks for that quiz. The top 10 quiz scores will count toward the final course grade. To be eligible for this component, students must complete at least 13 quizzes; failure to do so will result in forfeiting the entire quiz portion of the grade.
- **Assignments/Labs:** There will be five labs to help you apply your understanding of the course material using CAD and simulation tools. Instead of formal reports, you will submit your results along with a brief discussion addressing whether the outcomes are expected and logically sound. Marks will be awarded based on the completeness of your solution and the clarity of your results, including proper presentation of units and assumptions. Each lab carries equal weight and covers the most recently discussed topics in class. Lab questions and results may be referenced in quizzes and the final exam. Submissions are due by 11:59:59 PM on the

specified due date. Makeup labs will not be offered. Late submissions will incur a 30% penalty for each 24-hour period or part thereof starting immediately after the deadline.

- **Take-Home Exam:** This course includes an individual take-home exam covering all topics. Marks will be awarded based on the completeness and clarity of your solutions, including the proper presentation of units, assumptions, calculation steps, and explanations, rather than solely providing the correct answer. The final exam is for evaluation purposes only and will not be returned to students.

Missed Test Policy: Students who claim extenuating circumstances defined in the [Academic Consideration Policy](#), as a reason for missed Final Test are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases. This must occur no later than three (3) days after the Test. Failure to do so will result in forfeiting the grade for the Test.

Academic Regulations and Dates: Students should be aware of the academic regulations and dates (e.g. last day for academic withdrawal) posted <https://calendar.carleton.ca/grad/gradregulations/>

Academic Integrity and Plagiarism

- Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity> Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or expulsion.
- One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own**. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
 - using another’s data or research findings without appropriate acknowledgement;
 - submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own; and
 - failing to acknowledge sources of information through the use of proper citations when using another’s work and/or failing to use quotations marks.
- Regarding Generative Artificial Intelligence (AI): “As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.” Unless otherwise noted during class activities, you

may only use any Gen AI technologies to aid or nuance your thinking, communication, and learning; but not to replace or subvert it.

Copyright: The materials (including the course outline, slides, posted notes, videos, labs, projects, assignments, quizzes, exams, and solutions) created for this course are intended for personal use only. They may not be reproduced, redistributed, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without written permission from the author(s), both during and after the semester.

Learning and Working Environment: The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca. We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

Academic Accommodations: Regarding Academic Accommodations: "Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).” For an accommodation request the processes are as follows:

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at **613-520-6608** or pmc@carleton.ca.

You should request your academic accommodations in the [Ventus Student Portal](#), for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. Please consult the [PMC website](#) for the deadline to request accommodations for the formally scheduled exam (if applicable).

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or

as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF\)](#).

Pregnancy Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

Religious Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF\)](#).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the [Sexual Violence Prevention & Survivor Support](#).

Student Mental Health and Wellness: As a university student you may experience a range of mental health challenges that can significantly impact your academic success and overall well-being. Carleton's [Wellness Services Navigator](#) is designed to help students connect with mental health and wellness resources.

Here is a list of on-campus and off-campus recourses:

1. **Carleton's Wellness Desk:** Located at 204A MacOdrum Library, is a space for students to learn about resources, connect with our Wellness Coordinator, and decompress during stressful times of the year. You can pop into the Wellness Desk any time during its hours of operation – no appointments necessary! <https://wellness.carleton.ca/mental-health/wellness-desk/>
2. **Carleton's Health and Counselling Services:** To book an appointment contact the main clinic by calling (613) 520-6674. If urgent, let the Patient Care Coordinator know or go in person to the main clinic (2500 Carleton Technology and Training Centre Building) and indicate that they are in crisis and need to speak to someone right away. <https://carleton.ca/health/>
3. **Residence Counselling and Wellness Service:** Counselling services specifically for students in residence. <https://carleton.ca/health/residence-counselling/>.
4. **Good2Talk (1-866-925-5454):** Good2Talk is a free, confidential helpline providing professional counselling and information and referrals for mental health, addictions and well-being to post-secondary students in Ontario, 24/7/36 <https://good2talk.ca/>
5. **The Walk-In Counselling Clinic (off-campus community resource):** The walk-in Counselling Clinic have offices in various locations across Ottawa and the greater Champlain region that are open 7 days a week. Individuals will be assisted, with no appointment, on a first-come, first-serve basis during the Walk-in Counselling Clinic hours. The Walk-in Counselling Clinic **offers services in many**

languages and is free and confidential. More information can be found at: <https://walkincounselling.com/>

6. **Distress Centre of Ottawa and Region:** Available 10am-11pm, 7 days/week, 365 days/year. **Distress Line:** 613-238-3311, **Crisis Line:** 613-722-6914 or 1-866-996-0991, **Text:** 343-306-5550. <https://www.dcottawa.on.ca/>
10. **Distress and Crisis Ontario, Available for chat 2 pm – 2 am EST.** <https://www.dontario.org/>
11. **BounceBack Ontario:** (Toll-Free: 1-866-345-0224) is a free skill-building program managed by the Canadian Mental Health Association (CMHA). It is designed to help adults and youth 15+ manage low mood, mild to moderate depression and anxiety, stress or worry. Delivered over the phone with a coach and through online videos, you will get access to tools that will support you on your path to mental wellness. <https://bouncebackontario.ca/>.

General Regulations:

- **Attendance:** Students are expected to attend all required lectures. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 1.2, Course Selection and Registration and Section 1.5, De-registration.
- **Copyright:** The materials created for this course (including the course outline and any slides, posted notes, labs, project, assignments, quizzes, exams and solutions) are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).
- **Health and Safety:** Respecting lab safety precautions and following directions of lab staff is essential to keep everyone safe. General lab safety precautions are still important and can be found at <https://carleton.ca/ehs/programs/working-lab/laboratory-health-and-safety/>.
- **Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current Calendar, Academic Regulations of the University, Section 2.6, Deferred Term Work.
- **Appeal of Grades:** The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the Calendar, Academic Regulations of the University, Section 2.7, Informal Appeal of Grade and Section 2.8, Formal Appeal of Grade.
- **Academic Integrity and Plagiarism:** Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: <https://carleton.ca/registrar/academic-integrity/> and the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: <https://carleton.ca/engineering-design/current-students/fed-academic-integrity>. Violations of



the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or expulsion. One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source. Examples of violations of the policy include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
 - using another’s data or research findings without appropriate acknowledgement;
 - submitting a computer program developed in whole or in part by someone else, with or without modifications, as one’s own; and
 - failing to acknowledge sources of information through the use of proper citations when using another’s work and/or failing to use quotation marks.
- **Learning and Working Environment:** The University and all members of the University community share responsibility for ensuring that the University’s educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca. We strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone’s personal beliefs, choices, and opinions.
- **Student Mental Health Service:** As a university student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. Carleton's Wellness Services Navigator <https://wellness.carleton.ca/navigator/> is designed to help students connect with mental health and wellness resources. If you need to talk to someone, please reach out for assistance: <https://carleton.ca/health/emergencies-and-crisis/>.
- **Generative Artificial Intelligence (AI):** Use of generative AI tools (such as ChatGPT) in course work is prohibited unless explicitly authorized by the course instructor for specific elements of the course. Submission of AI generated work without authorization may lead to an academic integrity investigation.
- **Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at <http://www.carleton.ca/equity/>

For an accommodation request, the processes are as follows:



- **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made.
- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see: <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>
- **Pregnancy obligation:** concept the instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see: <https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>
- **Religious obligation:** concept the instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see: <https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>