

GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 6445

POWER INTEGRATED-CIRCUIT DESIGN

Fall 2024

INSTRUCTOR: Prof. Gabriel A. Rincón-Mora, Ph.D.
E-Mail Address: Rincon-Mora@gatech.edu
URL: Rincon-Mora.gatech.edu

LECTURES: Mondays/Wednesdays at 11:00 a.m. – 12:15 p.m. in Van Leer C456

OFFICE HOURS: Course Questions: Q & A Sessions on Fridays at 2:00 p.m. with Zoom
Academic Standing/Personal Matters: Send e-mail for consultation

COURSE URL: Rincon-Mora.gatech.edu/classes

COURSE SYLLABUS: Linked under "ECE 6445 Power Integrated Circuit Design" link

COURSE DESCRIPTION: ECE 6445 teaches how to analyze and design CMOS switched-inductor dc–dc power supplies. The underlying aim of the course is to cultivate and develop the skillset necessary to model (steady state and across frequency), analyze (steady-state, across-frequency, and time-domain signals), and design dc–dc power-supply systems. The course reviews and details how diodes and MOSFETs conduct current and power; switched inductors operate, transfer and consume power, and respond (across frequency); and feedback circuits control and stabilize power-supply systems. The material places emphasis on insight and intuition and presents a perspective on design that transcends math and fosters innovation.

PREREQUISITE: None

EDUCATIONAL OUTCOMES: Upon successful completion of this course, students should be able to:

1. Analyze and design dc–dc switched-inductor CMOS power supplies.
2. Identify and quantify power losses.
3. Analyze frequency response and feedback dynamics.
4. Analyze and design feedback controllers.
5. Use SPICE to simulate switched-inductor power supplies.

GRADE COMPOSITION:

Midterm Exam	= 30%
Final Exam	= 35%
Assignments	= 30%
Class Attendance/Professionalism (Adherence to syllabus & ECE policies)	= 5%

Possible extra credit for distinguishably extraordinary effort.

IMPORTANT DATES:

First Day of Class	August 19 (Monday)
Midterm Exam	October 9 (Wednesday)
Last Day to Drop Course	October 26 (Saturday)
School Recess	Sept. 2 (Mon.), Oct. 14 (Mon.), Nov. 27 (Wed.)
Last Day of Class	December 2 (Monday) – Last assignment due on this date
Final Exam	Date from Oscar.gatech.edu: Calendars > Final Exam Matrices

TEXTBOOK: *Switched Inductor Power IC Design*. New York: Springer Nature, 2022.

LECTURES FROM: *Power IC Design*. New York: KDP (www.amazon.com/dp/B0C6BYVTF2).

USEFUL RESOURCES: "SPICE Page" & "Educational Videos" on class URL

ADVICE: Review material presented after each lecture, write notes, and ask questions.
Bring book to class, mark figures/equations presented, and refer to them in your notes.

COURSE EXPECTATIONS AND GUIDELINES

*Format

IN CLASS: No auditors allowed.

Be seated & ready before class begins (penalty points for being absent or late).

Cellular phones, laptops, & tablets must be off & out of sight.

No smoking or eating in class.

Students are responsible for all material & information announced in class & over e-mail.

EXAMS: No textbooks or notes allowed.

Calculators cannot be used in programmable mode.

No make-up exams (without prior approval two or more weeks in advance).

In case of medical emergencies, work with the Office of the Dean of Students.

Grades become final one week after exams are graded and returned.

*List problems in numerical order, circle & mark answers clearly, & staple pages together.

ASSIGNMENTS:

No collaboration allowed (unless otherwise stipulated).

No late submissions without prior approval (submit request no later than 48 hours before due date/time).

Allowed late submissions lose 20% for each day they are late (including weekends).

Grades become final one week after they are available.

*Include a cover sheet with the course name and number, your name, date, & assignment number.

*List problems in numerical order & circle & mark answers clearly.

PREPARING FOR CLASS: Review previous lecture and read ahead.

PREPARING FOR EXAMS: Review notes and textbook and re-do examples and assignments (without the key).

ASSISTANCE: Provided in direct proportion to demonstrated effort in your own attempts to understand and resolve misunderstandings.

ACADEMIC INTEGRITY: All Georgia Tech (GT) students must know and follow GT's Academic Honor Code (<https://catalog.gatech.edu/policies/honor-code>). In accordance with the Honor Code, I expect your cooperation in reporting suspicious acts relating to academic misconduct. I must and will therefore report all instances of academic dishonesty to the Office of Student Integrity, who will investigate incidents and mandate appropriate penalties for violations. So out of respect for your peers, professors, Georgia Tech, and alumni, please do not engage in dishonest activities in or outside of class.

STUDENT-FACULTY EXPECTATIONS: At Georgia Tech, we strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and students. See <https://catalog.gatech.edu/rules> for basic expectations that you can have of me and I of you. Respect for knowledge, hard work, and cordial interactions will help build the environment we seek, so please remain committed to these ideals in and outside of class.

INSTITUTE ABSENCE POLICY: See Georgia Tech's policies on absences at <https://catalog.gatech.edu/rules/4>.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES: If you have learning needs that require special accommodations, schedule an appointment with the Office of Disability Services at disabilityservices.gatech.edu to discuss your needs and send me a note that explains your situation and their recommendations **before the second week of classes begins**.

COURSE OUTLINE

1. Power-Supply Systems
2. Power Devices
3. Switched Inductors
4. Power Losses

5. Frequency Response
6. Feedback Control
7. Control Loops
8. Building Blocks [as time allows]