

**GEORGIA INSTITUTE OF TECHNOLOGY**  
**School of Electrical and Computer Engineering**

**ECE 6445**

**POWER INTEGRATED-CIRCUIT DESIGN**

**Fall 2023**

**INSTRUCTOR:** Prof. Gabriel A. Rincón-Mora, Ph.D.  
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**LECTURES:** Mondays/Wednesdays at 3:50 – 5:05 p.m. in Room 404

**OFFICE HOURS:** Q & A Sessions on Thursdays at 1:00 – 2:00 p.m. (for course questions)  
Pose individual/academic-standing questions over e-mail.

**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% |
| Assignments                                                                           | = 30% |
| Final Exam                                                                            | = 35% |
| Class Attendance/Professionalism (Adherence to syllabus & ECE policies)               | = 5%  |
| Possible extra credit for distinguishable and extraordinary effort & professionalism. |       |

**IMPORTANT DATES:**

|                         |                                                            |
|-------------------------|------------------------------------------------------------|
| First Day of Class      | August 21 (Monday)                                         |
| Midterm Exam            | October 16 (Monday)                                        |
| Last Day to Drop Course | October 28                                                 |
| School Recess           | September 29 – October 7                                   |
| Last Day of Class       | November 29 (Wednesday) – Last assignment due on this date |
| Final Exam              | T.B.D.                                                     |

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

**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 and ready before class begins.

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

No smoking or eating in class.

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

**EXAMS:** No textbooks or notes allowed.

Calculators cannot be used in the 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 and circle and mark answers clearly.

**ASSIGNMENTS:**

No collaboration allowed (unless otherwise stipulated).

No late submissions without prior approval (request should be received before due date).

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

Grades become final one week after they are available.

Start assignments when first announced so questions can be posed early.

\*Add a cover sheet that includes course name and number, your name, date, and assignment number.

\*List problems in numerical order and circle and 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 ([www.catalog.gatech.edu/policies/honor-code](http://www.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 [catalog.gatech.edu/rules](http://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 [www.catalog.gatech.edu/rules/4](http://www.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](http://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]