GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 3400 **ANALOG ELECTRONICS** **Spring 2025**

INSTRUCTOR: Prof. Gabriel A. Rincón-Mora, Ph.D.
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LECTURES: Mondays/Wednesdays at 3:30–4:45 p.m. in Van Leer C456

OFFICE HOURS: Course Questions: Q & A Sessions on Tuesdays at 7:30 p.m. with Zoom
Academic Standing/Personal Matters: Send e-mail for consultation

COURSE URL: Rincon-Mora.gatech.edu/classes
SPICE Simulator: Linked under "SPICE Page" link
Syllabus: Linked under "ECE 3400 Analog Electronics" link

PREREQUISITE: ECE 3040 Microelectronic Circuits

COURSE DESCRIPTION: ECE 3400 extends the concepts of semiconductor devices, circuits, and applications begun in ECE 2040 and 3040 and provides a continuation of concepts, problem-solving techniques, and tools needed for subsequent courses in electronics. The material presents, explains, and shows how to use electrical components to model, analyze, and design filters, clamps, rectifiers, peak detectors, op-amp circuits, transistor amplifiers, and oscillators. The underlying aim is to cultivate and develop insight and intuition for how electronic devices work individually and collectively in analog circuits. The material presents an engineering perspective on circuits that transcends math and fosters innovation.

EDUCATIONAL OUTCOMES:
1. Analyze first-, second-, and bi-quadratic passive/active filters.
2. Analyze clamps, rectifiers, and peak detectors.
3. Analyze negative-feedback circuits.
4. Analyze amplifiers and oscillators with BJTs and MOSFETs.
5. Use SPICE to simulate circuits.

GRADE COMPOSITION:

First Midterm Exam	= 20%
Second Midterm Exam	= 25%
Final Exam	= 30%
Assignments	= 20%
Class Attendance/Professionalism (Adherence to syllabus & ECE policies)	= 5%

Possible extra credit for distinguishably extraordinary effort.

IMPORTANT DATES:

First Day of Class	January 6 (Monday)
School Holiday | Recess	January 20 (Mon.) | March 17–21 (Mon.–Fri.)
First | Second Midterm Exams	February 10 (Monday) | March 12 (Wednesday)
Last Day to Drop Course	TBD (TBD)
Last Day of Class	April 21 (Monday) – Last assignment due April 21
Final Exam	April 30 (Wednesday) at 2:40–5:30 p.m. in VL 456

LECTURES FROM: *Analog Electronics*, *2nd Edition*. New York: KDP (www.amazon.com/dp/B0C47R2KQP).
TEXTBOOK: *Microelectronic Circuit Design*, *6th Edition*. McGraw-Hill, 2023.
REFERENCES: *Switched Inductor Power IC Design*, Springer. 2022 (on-line access with GT Library).
Analog IC Design with Low-Dropout Regulators, *2nd Edition*. McGraw-Hill, 2014.
YouTube videos linked on class URL under "…YouTube Videos…" link.

ADVICE: Review material presented after each lecture, write notes, & ask questions.
Bring book to class & annotate on it or refer to it in your notes.

COURSE EXPECTATIONS AND GUIDELINES

*Format

IN CLASS: No recordings/photos allowed.
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 & with Canvas.

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 & read ahead material to be covered in class.

PREPARING FOR EXAMS: Review lectured slides & notes & re-do examples & assignments with & without the key.

ASSISTANCE: Provided in direct proportion to demonstrated effort
in your own attempts to understand & 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. RCL Filters
2. Op-Amp Circuits
3. Transistor Amplifiers
4. Frequency Response
5. Op Amp
6. Diode Circuits
7. Oscillators

READING & VIEWING MATERIAL

A. *Microelectronic Circuit Design*, 6th Edition, McGraw-Hill, 2023.
B. *Switched Inductor Power IC Design*, Springer, 2022 (on-line access with GT Library).
C. YouTube videos linked on class URL under "…YouTube Videos…" link.

Chapter 1. RCL Filters	A. Sections 6.8, 9.1; B. Sections 5.2–5.4
1.1. RCL Basics	
1.2. Passive RC Filters	
1.3. Passive RL Filters	
1.4. Resonant LC Filters	
Chapter 2. Op-Amp Circuits	
2.1. Two-Port Models	A. Sections 1.5.2, 6.3; B. Section 5.1; C. Frequency: FR1
2.2. Negative Feedback	A. Section 11.3; B. Section 6.1
2.3. Summers	A. Sections 1.5.1, 1.7.1, 10.1–10.2; B. Section 6.2
2.4. Filters	A. Section 10.3; B. Section 6.3.3
2.5. Practical Op Amps	A. Sections 1.7.2, 11.2; B. Section 6.3.4
Chapter 3. Transistor Amplifiers	
3.1. Semiconductor Devices	A. Sections 3.1–3.4, 3.7, 4.1–4.9, 4.11, 5.1–5.4, 5.8–5.9, 5.14–5.15, 7.5, 7.8–7.9; B. Sections 1.2, 1.4, 2.2–2.4 C. Devices: D3, D5–6, D10, D12
3.2. Common Emitter/Source	A. Sections 7.6, 7.10–7.11, 8.2; C. Primitives: X1–2
3.3. Common Base/Gate	A. Section 8.4; C. Primitives: X3–4
3.4. Common Collector/Drain	A. Section 8.3; C. Primitives: X5
3.5. Super-β (Darlington) BJT	A. Section 13.2.3
3.6. Multi-Stage (Cascade) Amplifiers	A. Section 7.2, 8.9; C. Primitives: X6
Chapter 4. Frequency Response	
4.1. Frequency Response	A. Section 9.6.1.; C. Frequency: FR6–7
4.2. Common-Emitter/Source Stage	A. Sections 8.7.1, 9.3.1–9.3.2, 9.6
4.3. Common-Base/Gate Stage	A. Sections 8.7.3, 9.3.3–9.3.4, 9.7
4.4. Common-Collector/Drain Stage	A. Sections 8.7.2, 9.3.5–9.3.6, 9.8
4.5. Cascode Stage	A. Section 9.10.3
4.6. Multi-Stage (Cascade) Amplifiers	A. Sections 8.10, 9.10
Chapter 5. Op Amp	
5.1. Linearity	A. Section 6.6
5.2. Current Mirror	A. Section 14.2
5.3. Differential Stage	A. Section 13.1
5.4. Op Amp	A. Section 13.2
Chapter 6. Diode Circuits	
6.1. Analog Logic	A. Sections 3.10–3.11
6.2. Clamps	
6.3. Rectifiers	A. Sections 3.13–3.16
6.4. Peak Detectors	A. Sections 3.13–3.16
Chapter 7. Oscillators	A. Sections 12.7, 15.6
7.1. Basics	
7.2. Phase-Shift Oscillators	
7.3. Resonant Oscillators	
7.4. Relaxation Oscillators	