ECE 3084 Signals and System	GT-E
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Office Hours: By appointment	WhatsApp and Text (NO voice, emergencies only!) +1 404 717 3085

Objectives:
• To introduce students to continuous-time linear systems and signals, their mathematical representations, and computational tools; Fourier and Laplace transforms, convolutions, input-output responses, stability.

Text: Chen, *Signals and Systems*, (3rd), Oxford University Press, 2004. 978-0195156614 (recommended) (comment: This book may also be available for purchase electronically or used. Other editions are OK.)

Optional means first check out the book and see if you want to purchase it. But, the class notes will be adequate if you do not want to go to the expense of purchasing a book or if you do not want to carry one around.

I WILL POST MY CLASS NOTES ON CANVAS.

Grading Policy

There will be three quizzes. Each quiz is worth 25 % of the course grade. Quiz dates are to be announced on the separate Course Calendar. The use of a calculator will NOT be allowed unless I later give instructions to the contrary. I will provide formula sheets as appropriate. *Any request for regrading of a quiz assignment must be made in writing within one week of getting the quiz back.* Such requests have two components: (1) A hard copy of the graded quiz and (2) a description of what you think was graded in error **on a separate sheet of paper.** There will be no make-up quizzes for any reason other than an official GT activity or an unforeseen emergency (for example, family emergency, illness). Illness is an appropriate reason for missing a quiz, but you may need to produce a note from a doctor, the representative of the dean of students, or Prof. Paul Voss stating that you are not able to take the quiz. The final exam is worth 25 %.

Note that if your quiz grades are sufficiently high, you can opt out of the final exam in which case I will use your quiz average for the final-exam grade.

Course Grade: The course grade will be computed according to the following weights:
Each quiz (3): 25 %
Final Exam: 25 %

Class Attendance Policy:
Regard attendance to be required, though there is no grade (but see below) and I will not take attendance. Students are expected to attend lectures and be engaged with the class. Class attendance is also the easiest way I know of to attain a first attempt at an understanding of the material. (Of course, this has to be supplemented by working homework problems and other practice.) In addition, quizzes and other in class assignments may require you to be present in class. Note that your presence in the class is required on days of myDAC labs. Students not present might receive a grade of zero for such labs missed.

Quizzes
There will be three in-class quizzes (or possibly online) tentatively on dates to be determined. **Failure to take a quiz will result in a grade of zero** unless you present written documentation that you have a valid excuse and that I accept the excuse (see above). Unless the excuse is related to an obviously unforeseen emergency, this documentation **must** be presented one week prior to the quiz or a grade of zero may result. The only excuses I will accept are official university or program activities of unforeseen emergencies. Personal travel is NOT an excuse.

The quizzes will be heavily drawn from problems given in the homeworks. Thus, mastery of homework problems is likely to translate into high quiz grades. The quizzes will be substantial and each quiz may be a fraction of the class period or the entire period as will be announced. It is your responsibility to arrive on time.

Each quiz will concentrate on material covered between specified cutoffs (TBA)—typically from the cutoff for the previous quiz. Nonetheless, knowledge of material that came before in the course will be required.

I will provide formula sheets for the quizzes. Calculators and other aids will **not** be permitted on the quizzes.

Note that Quiz 3 may be scheduled during dead week.

Office hours

By appointment. Please email me as I may not have my calendar with me at lectures.

Homework

Problems will be assigned roughly every week. Student collaboration on homework is permitted. Homework will NOT be graded, but solutions will be posted. Homework is an essential part of the course as problem solving is how most of us learn. It will also help prepare you for the quizzes.

Student-Faculty Expectations Agreement
A university is a place where scholars engage in free inquiry into a range of subjects. It is therefore necessary to foster an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. I also emphasize that the class provides an excellent opportunity to ask questions—both about specific subject-matter related material as well as about, well, anything. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Academic Conduct:
Students in this class are expected to abide by the Georgia Tech Honor Code and avoid any instance of academic misconduct, including but not limited to:

- Possessing, using, or exchanging improperly acquired oral or written information in the preparation of a quiz or lab report.
- Submission of material that is substantially identical to that created or published by another individual, except as noted below.
- False claims of performance or work that has been submitted by the student.

Be sure to report observed instances of violations of the Honor Code! Remember, the Honor Code is about honor. Apart from devaluing your own work, the work of your classmates, and the Georgia Tech degree, Violations of the Honor Code carry significant penalties, here at Tech, and for life. Do you want to be labeled as having cheated? The trustworthiness of engineering and science (as well as the reliability and safety of products!) relies on the basic honesty of engineers and scientists. Students may work in groups of on homework assignments, though each must student make a good-faith effort to contribute to the group. Each student must also write up and turn in his/her work to integrate the knowledge.

Further information concerning materials and other aids allowed in quizzes will be given later.
See the Georgia Tech Honor Code for further information or ask instructor.

Communications:
You are responsible for all announcements (which may include information about the problem sets,

quizzes, and labs) made in class. Problem sets and quizzes will likely strongly reflect material covered in class. If you miss class, do not ask me what was covered. Handouts may also be distributed from time to time in class; it is your responsibility to obtain information from classmates if you are not present when information is given or materials are distributed. I may also email the class various information. The alias for the class corresponds to the list of those students registered for the course. Thus, if you are not getting emails, you are probably not registered. (Wait until I announce in class that I am emailing information. This will probably happen toward the end of the first week of class.) It is your responsibility to save emails containing information about the class.

Notes, problem sets, solutions, and various other useful information will for the most part be posted on Canvas.

The best way to contact me is via email (**put "ece2040" in the subject line!!!**), briefly immediately after class (but another class may need the room), or by appointment.

Miscellaneous:
Cell phones and similar devices must be turned **off** in class.

Course Outcomes

1. Express continuous-time signals in mathematical form
2. Define and apply the Fourier transform
3. Analyze signals in terms of their frequency contents
4. Describe system behavior in terms of the Fourier transform
5. Apply the Laplace transform
6. Solve linear, ordinary differential equations using the Laplace transform
7. Derive transfer function representations of linear systems
8. Relate system stability to the properties of the transfer function
9. Explain the role of feedback in linear systems
10. Describe how continuous-time signals and systems are used in engineering applications

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
"M" for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
"LN" for "little to none" indicates that the course does not contribute significantly to this outcome.
1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. (M) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. (LN) An ability to communicate effectively with a range of audiences

4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. (P) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. (LN) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Tentative Outline

1. Introduction and motivation
a. Engineering approximations and mathematical abstractions
b. Continuous-time vs. discrete-time signals and systems
c. Linear systems (superposition)
d. Time invariance

2. Frequency-domain signal analysis
a. Fourier series
b. Continuous-time Fourier transforms
c. Properties of Fourier transforms

3. Frequency-domain characterizations of linear systems
a. Transfer functions (jw)
b. Frequency responses

4. Time-domain characterizations of linear systems
a. Differential equations
b. Convolution
c. Lumped vs. distributed systems

5. Discrete-time representations of continuous-time signals
a. Nyquist sampling
b. Filters (A/D -> filter -> D/A cascade)

6. Laplace-domain signal analysis
a. Forward and inverse Laplace transforms
b. Properties of Laplace transforms
c. Initial and final value theorems
d. Convolutions
e. Connections between Fourier and Laplace transforms

7. Laplace-domain characterizations of linear systems
a. States
b. Laplace-domain representation of ODEs
c. Transfer functions (s); poles and zeros
d. Responses (zero state, zero input)
e. Laplace-domain electric circuit analysis
f. Stability
g. Feedback

Typical in-class labs may include:
Sensing and data filtering
Proportional feedback design
Signal generation and frequency analysis