

Syllabus: ECE-S301: Signals and Systems I

Fall 2021-2022 - Rev 0

Lecture instructor: Dr. Thomas Chmielewski Bossone 413-H tac29@drexel.edu
Office Hours: Available via email to answer course related questions. Worst Case 24 hr turnaround.
Office hours: to be determined after first week

Recitation Lecturer **Dr. Fernand Cohen** fsc22@drexel.edu
Office hours: to be determined after first week or questions by email

Teaching Assistant:
TBD: Office: Bossone; email: unknown@drexel.edu
Office hours: To be determined after first week or questions by email

Prerequisites: ECE 201 and (ENGR 231 or MATH 261 or MATH 201); ENGR232/Differential Eqs. helpful

Course Material:

- Quality scans are required for uploads— *no hand copying of material will be permitted*. Alternatively you can edit the pdf provided (practice before quiz)
- Text:** *Signals and Systems, 2nd Edition*, by Alan V. Oppenheim and Alan S. Willsky with S. Hamid Nawab. Publisher: Pearson. ISBN: 9780138147570. **THIS TEXT IS REQUIRED**
- Reference Text:** Schaum's Outline Series: Signals and Systems by Hsu - very low cost/also on line - any edition is fine (**extremely helpful has solved problems**)

Lectures Tuesday and Thursday : 12:30 PM-1:50 PM Randel 326 check since this can change

Recitation: Friday: sec 60: 9:00 AM – 10:50 AM sec 61 11:00 AM – 12:50 PM Curtis 457 again check

TENTATIVE Topical Outline by Week with associated reading.

The order of presentation may be modified— so you will need to check BBlearn each week; however, this is a good guide for those who wish to prepare. **The official reading list is listed below.** You should check off key listed topics in your notes as we go through the material. See Course Change Policy last page.

Week 1: Chapter 1 (1.0 – 1.3 part 1.4)

Introduction – what is the course about and expectations; a review of complex numbers; Periodic signals; transformation of independent variable, odd/even functions, power/energy; complex exponentials (CT only)

Week 2: Section 1.4 thru 1.7 and section 2.1

Dirac delta function for DTS and CT; sifting property; Unit step DTS, CTS, Systems: series, cascade, feedback configuration; Basic properties: Memory, Invertibility and Inverse System, Causality, BIBO Stability, Time Invariance, Linearity (including examples and tests for each as done in text) Given an LTI and $x_1(t) \rightarrow y_1(t)$, finding output for linear combinations of shifted $x_1(t)$, Derivation of DTS convolution showing impulse response $h[n]$ – also time varying impulse response; DTS -Convolution example – using fold and shift from convolution, graphic method of using shifted impulse to get shifted impulse response then add up weighted responses and synthetic multiplication.

Week 3: Section 2.2 thru 2.3, part of 2.4; Sections 3.0-3.2

operator notation CT convolution example, properties of LTI systems; block diagram reduction; eigenfunctions into LTI system; complex exponentials with periodicity; how to find $y[n]$ for a DT system using convolution expansion; Fourier series with no computations. IFS for square wave with different numbers of coefficients

Week 4 (Text 3.5, 3.9, 3.10 no Discrete Time F.S) Midterm 1

C.T.F.S. synthesis equation and analysis equation; Periodic signal example pulse of width 1, height 1 repeating every 3 seconds; Dealing with c_0 , the DC component
Linear algebra basis of F.S., basis vectors orthogonal vectors; Orthogonal functions

Syllabus: ECE-S301: Signals and Systems I

Fall 2021-2022 - Rev 0

Writing F.S form from simple periodic functions: $2 + \cos(2t + \pi/2)$; Interpretation of fundamental frequency and harmonics; Error of F.S representation vs actual function; Dirichlet two key bullets; Gibbs phenomenon as $N \rightarrow \infty$ what happens?

Week 5 (Text 3.5, 3.9, 3.10 no Discrete Time F.S)

Properties of C.T.F.S – linearity, time shifting, time reversal, time scaling, multiplication, conjugate symmetry, real and even; Parseval's Relationship, Differentiation, F.S. of impulse train

Week 6 (Text sections 4.0 thru 4.4)

Derivation of C.T.F.T. for an aperiodic signal by letting T approach infinity; Convergence of C.T.F.T – Dirichlet Conditions; Fourier transform of $\exp(-at)u(t)$ $a > 0$ including magnitude plot and phase plot; key values of each at frequency $\omega = \pm a$ (magnitude = $\sqrt{2}/(2a)$, phase = $\pm \pi/4$); FT of delta function and spectrum; FT of limited duration pulse $x(t) = 1$ $|t| \leq T_1$ and 0 for $|t| > T_1 \rightarrow$ sinc function and its plot; FT of periodic signals as well as $\sin()$ and $\cos()$; Properties of C.T.F.T - linearity, time shifting, conjugation, differentiation and integration, time and freq scaling, duality, Parseval's relationship, convolution, AM; Parseval defined energy density spectrum, Properties of LTI systems (block diagrams) with $H(j\omega)$; Partial fraction expansion

Week 7 (Text sections 4.5 thru 4.8)

Understanding of Ideal Low Pass filter in frequency domain; Example of step input into LTI system $h(t) = \exp(-at)u(t)$ solved by Fourier Transform and Partial Fraction expansion. Also step on step off waveform. Plotting response; Example of RC network frequency response (can you do an RL?)
Time domain multiplication formula; AM modulation done mathematically and graphically; Solving Linear constant Coefficient Differential Equation using C.T.F.T.; Introduction to Bode plot (magnitude of $H(j\omega)$ but $20\log_{10}(\text{magnitude of } H(j\omega))$ with phase in degrees – be able to predict what comes out if you put in $x(t) = 10\cos(100t)$ in terms of $y(t)$ with amplitude, frequency and phase

Week 8-9 (Text 5.0 thru 5.8 and DTFS text 3.6-3.7) plus notes and codes Midterm 2 Week 8

DTFS as prelude to DTFT see sec 3.6-3.7) and notes; DTFT – analysis equation and synthesis equation; Periodicity in 2π ; Convergence; DTFT of periodic signals; Properties; Plotting Magnitude and phase of DTFT for a given $h[n]$; Application of Nulling filter (convolution in DT domain and reading off magnitude and phase from DTFT plot)

Week 10 (Text 7.0-7.2) and posted notes and codes Plus review for final

Sampling theory; Diagram of ideal sampling and reconstruction with ideal low pass filters. Notes on relationship between CTFT and DTFT of sampled signal; Finish any outstanding topics,

Course format:

- There are two lectures, a recitation session, and a quiz per week – (yes there is a quiz the 1st week)
- Lectures are a mix of pdf notes and “live” material – you should be prepared to take notes. The printed material will be posted on **BB Learn** so you can download for class. “Live material” may be extemporaneous so the only notes that will exist are those you take.
- See outline in Syllabus for reading assignments.
- Homework, recitation, and instructor problems will be posted weekly on **BB Learn**
- Students should check their Drexel email and BB Learn, frequently for announcements and the night prior to class for any notes/materials that may be posted, please print these out and annotate them during class.
- Each recitation will include an application or Theory portion by Dr. Cohen and interactive problem solving with the TA, students need to prepare for the recitation by looking over the recitation problems and having questions ready to discuss. The quiz is given at the end of recitation.

Homework format:

- You must include the cover sheet provided with each homework posting as the first sheet of your submission or you receive no credit for the Homework assignment
- Homework is due by upload weekly by end of day (11:59 PM – not 12:01 AM) on the Monday following lectures (starting week 2); solutions will be available the next day around noon.
- Your scans must be printable or easy to read – a darkened background that is hard to read will result in a point penalty – if we cannot read it, we will **not** mark it (same goes for written midterms)

Syllabus: ECE-S301: Signals and Systems I

Fall 2021-2022 - Rev 0

- We will select several problems (randomly each week) for detailed checking – others will be checked for attempt. You have access to posted solutions for each problem assigned.

Missed HW/Quiz/Midterm – any reason

- If you are sick you must email the instructor **BEFORE** a scheduled midterm/final. If you are sick you must present a doctor's note to take the make up exam or quiz.
- **Missing HW - contact the TA, NOT the instructor.** Do not mail HW to the instructor.
- Religious Holiday – contact the instructor
- If in doubt email. Also see Drexel University policies at the end of this syllabus.

Quiz -Weekly

- A short quiz will be given each week. **More information later.** Topics will be announced in lecture. It may contain material from the current week's first lecture, but the main content will be from the prior week.
- Quiz format may vary from: (1) on-line multiple choice or fill in answer; (2) written problems with partial credit
- **There is a quiz the first week on complex numbers.**

Midterms/Final

- There are two midterms. More information later.
- The final is as scheduled by the provost, you need to adjust YOUR schedule to be able to take the final.

Grading:

HW	15%	Based on marking of instructor selected probs and cover sheet info
Midterm #1	20%	Week 4 written with partial credit
Midterm #2	20%	Week 7 or 8 written with partial credit
Final Exam	25%	Cumulative but weighted more toward last material set, on-line
Quiz	20%	Drop lowest grade; total of 8-9 quizzes.

GRADE SCALE (nominal from Provost)

(A+)	97-100		A	93-9		(A-)	90-92
(B+)	87-89		B	83-86		(B-)	80-82
(C+)	77-79		C	73-76		(C-)	70-72
(D+)	67-69		D	65-66		F	Below 65

The course grade will be based upon the students' performance as follows: performance curves {A, A-, B+, . . . C-, D+, D, F} are determined based on averages, +/- standard deviations and grading gaps for total score.

Grading Issues:

If you wish to dispute the grading of a homework/quiz/exam, you must attach the homework/quiz/exam to a piece of paper outlining your complaint and return it to the TA within 2 business days after the homework/quiz/exam is returned. Any dispute of grading which does not follow these guidelines will not be accepted and may lead to a reduction in your grade.

Electronic Devices

- Electronic devices such as cell phones, pagers, blackberries, and laptops, and other not listed devices are **not allowed** to be active in the classroom during lecture. Using such electronic devices during lecture disturbs other students in the class as well as the instructor. In particular “**texting**” during a Lecture is **strictly forbidden**. Students who use such non-approved electronic devices will be directed to leave the classroom.
- Laptops/Surface-type devices **will be allowed** during lecture/recitation **if** they are used for notes.

Syllabus: ECE-S301: Signals and Systems I

Fall 2021-2022 - Rev 0

Additional Student Responsibility

- Each student must **frequently check their email and the BBlearn** for course information including updates to assignments, comments etc.
- Each student must **read and understand** the assigned material as well as any supplementary material provided on the web site.

Additional resources, getting help with the course:

- Your first line for help should be ACE. Previous students had a very good experience with this approach.
 - The ACE tutor for the winter is **UNKNOWN** who can be contacted at unknown@drexel.edu
- Individual or group Help - contact TA or instructor(s) ***with specific questions by email***, if necessary, additional help can be arranged.
- Students should try to get Schaum's Outline Series: **Signals and Systems by Hsu** any version (this is low cost on the web and many older pdf versions are online) the idea is to use the solved problems for help.
- When appropriate, a **Supplemental Material folder** will be posted in BBlearn containing additional material

Course Learning Outcomes

C98693: Identify linear/nonlinear and time-invariant/time-variant systems

C98694: Apply the Fourier Series analysis equation to periodic signals and be able to synthesize original waveform from F.S. coefficients,

C98695: Conduct Fourier transform analysis of aperiodic signals and LTI systems

C98696: Understand the sampling of signals and constraints on reconstruction

C98697: Apply the discrete-time Fourier transform (DTFT) to discrete time signals and systems

C007: Understand the application of simple filters to signals (both ideal and real world)

Key dates for Fall 2021-2021 - See link below for more details

<https://drexel.edu/provost/calendars/academic-calendars/quarters-2021-2023/>

- Classes begin Monday 20 Sept 2021
- Holiday Indigenous Peoples Day: Monday Oct 11, 2021
- Thanksgiving holiday begins end of day Tuesday 23 Nov 2021, classes resume Monday 29 Nov 2021
- Last day of classes: Saturday 4 Dec 2021
- Exam week: Monday Dec 6, 2021, thru Saturday 11 Dec 2021.

Drexel University's Policies:

Review policies available at <http://www.drexel.edu/provost/policies> as they pertain to undergraduate studies and in particular take please take note of:

Missed Classes: Absence from class will be based on the University's absence policy. Please review the link below. <http://drexel.edu/provost/policies/absence/>

Academic Integrity, Plagiarism and Cheating Policy: Please review the University policy regarding academic integrity: <http://drexel.edu/provost/policies/academic-integrity/>
http://drexel.edu/studentlife/community_standards/studentHandbook/

Syllabus: ECE-S301: Signals and Systems I

Fall 2021-2022 - Rev 0

Office of Equality and Diversity - Disability Resources: Students requesting accommodations due to a disability at Drexel University need to request a current Accommodations Verification Letter (AVL) in the ClockWork database before accommodations can be made. These requests are received by Disability Resources (DR), who then issues the AVL to the appropriate contacts. For additional information, visit the DR website at <http://drexel.edu/oed/disabilityResources/overview/> or contact DR for more information by phone at 215.895.1401, or by email at disability@drexel.edu.

Course Drop Policy: <http://drexel.edu/provost/policies/course-add-drop/>

Course Withdrawal Policy: <http://drexel.edu/provost/policies/course-withdrawal/>

Course Change Policy: The instructor reserves the right to modify the course, as necessary, during the term: including policies, evaluations, due dates, course content, schedule, assignments or requirements. All changes will be communicated in lecture and/or via the course DrexelLearn page.

Weather, Emergencies and University Closing: University closing or delayed opening information will be posted on www.drexel.edu. In the event of the need to close or delay the daily opening of a campus, the University will provide notice via Web, telephone, and the DrexelALERT system. Closing or delayed opening information will be announced at 215-895-MELT (6358).

The University determines whether to close or delay opening due to inclement weather, not the instructor. Therefore, please do not contact the instructor for this information.

Mask Etiquette for the 2021 Fall Quarter

As of August 3, 2021, [Drexel requires all students and employees to wear a mask](#) in all on-campus public and shared spaces, including instructional and research settings, regardless of vaccination status. Specifically, masks are to be worn in classrooms, laboratories, lecture halls and seminar rooms. Students are not permitted to eat during class or otherwise remove their mask. If a student needs to remove their mask (to drink water etc.) they may step outside the class, to do so and then return to class. Please remember your mask to avoid class disruption.

If a student does not wear a mask or follow other required health and safety guidelines in the classroom, the instructor will take the following steps:

- Ask the student to please correct their behavior. This may involve determining if there is a reason why the student is unable to comply with the request; for instance, they may not have a mask. If a solution to the problem can be easily identified, and the instructor is able to assist the student in complying, such as directing them as to where to find a mask, they will do so.
- If the student refuses to mask, the instructor will inform the student that they will be referred to Student Conduct and they will be asked to leave the class.

As members of the Drexel community, we all play a role in supporting our collective health and safety, and I appreciate your collaboration and commitment to this. If you have questions or concerns about masking in class, please do not hesitate to ask. More information about masking is available at the link above and on the [Drexel Response to Coronavirus website](#).