

EE445S Real-Time Digital Signal Processing Lab (Fall 2019)

Lecture:	MW 10:30am–12:00pm in PMA (RLM) 5.124
Instructor:	Prof. Brian L. Evans, bevans@ece.utexas.edu
Office Hours:	MW 9:00am–10:30am in EER 6.882
Lab Sections:	M 6:30–9:30pm (Cho), W 6:30–9:30pm (Cho), (EER 1.810) T 6:30–9:30pm (Jacobellis), F 1:00–4:00pm (Jacobellis)
TA Office Hours:	Mr. Yunseong Cho, W 4:30–6:00pm & TH 3:30–5:00pm (EER 1.810) Mr. Dan Jacobellis, TH 5:00–8:00pm
TA E-mail:	yscho@utexas.edu and danjacobellis@gmail.com
Course Web Page:	http://users.ece.utexas.edu/~bevans/courses/realtime

This course covers discrete-time signal processing concepts and translating them into real-time software. The goal is to understand design tradeoffs in signal quality vs. implementation complexity. Applications include audio, communications, and image processing.

Topical Outline

Architectures of programmable digital signal processors; programming for real-time performance; design and implementation of digital filters, modulators, data scramblers, pulse shapers, and baseband transceivers in real time; and interfaces to communication systems.

Order of Lecture Topics

Sinusoidal Generation – Digital Signal Processors – Signals and Systems – Sampling and Aliasing – Finite Impulse Response Filters – Infinite Impulse Response Filters – Interpolation and Pulse Shaping – Quantization – Data Conversion – Channel Impairments – Digital Pulse Amplitude Modulation – Matched Filtering – Digital Quadrature Amplitude Modulation

Prerequisites

EE 312 C Programming and 319K Intro to Embedded Systems with a grade of at least C- in each; BME 343 or EE 313 Signals and Systems with a grade of at least C-; credit with a grade of at least C- or registration for BME/EE 333T Engineering Communication; and credit with a grade of at least C- or registration for BME 335/EE 351K Probability.

Required Texts

1. C. R. Johnson Jr., W. A. Sethares and A. G. Klein, *Software Receiver Design*, Oct. 2011, ISBN 978-0521189446. Paperback. Matlab code.
2. T. B. Welch, C. H. G. Wright and M. G. Morrow, *Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs*, 3rd ed., Jan. 2017, ISBN 978-1498781015.
3. B. L. Evans, *EE 445S Real-Time DSP Lab Course Reader*. Available on course Web page.

Supplemental Texts

4. J. H. McClellan, R. W. Schafer, and M. A. Yoder, *Signal Processing First*, ISBN 978-0130909992, 2003. On-line demonstrations at <http://dspfirst.gatech.edu/>.

Grading

14% Homework, 20% Midterm #1, 20% Midterm #2, 5% In-Lecture Work, 5% Pre-lab quizzes, 36% Laboratory. Midterms will be held during lecture, with midterm #1 on Wednesday, Oct. 16th, and midterm #2 on Monday, Dec. 9th. Attendance/participation

in laboratory is mandatory and graded. Lecture attendance will help you connect the pieces of the class together and use your time more efficiently in focusing on what's important in the course. During lecture, please power off all phones and exclusively focus your use of other electronics on the content. Plus and minus letter grades might be assigned. There is no final exam. Request for regrading an assignment must be made in writing within one (1) week of the graded assignment being made available to students in the class. *Discussion of homework questions is encouraged. Please submit your own independent homework solutions.*

Student Rights and Responsibilities

- You have a right to a learning environment that supports mental and physical wellness.
- You have a right to respect.
- You have a right to be assessed and graded fairly.
- You have a right to freedom of opinion and expression.
- You have a right to privacy and confidentiality.
- You have a right to meaningful and equal participation, to self-organize groups to improve your learning environment.
- You have a right to learn in an environment that is welcoming to all people. No student shall be isolated, excluded or diminished in any way.

With these rights come responsibilities:

- You are responsible for taking care of yourself, managing your time, and communicating with the teaching team and with others if things start to feel out of control or overwhelming.
- You are responsible for acting in a way that is worthy of respect and always respectful of others.
- Your experience with this course is directly related to the quality of the energy that you bring to it, and your energy shapes the quality of your peers experiences.
- You are responsible for creating an inclusive environment and for speaking up when someone is excluded.
- You are responsible for holding yourself accountable to these standards, holding each other to these standards, and holding the teaching team accountable as well.

Personal Pronoun Use

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the students legal name, unless they have added a preferred name with the Gender and Sexuality Center. I will gladly honor your request to address you by a name that is different from what appears on the official roster, and by the gender pronouns you use (she/he/they/ze, etc). Please advise me of any changes early in the semester so that I may make appropriate updates to my records.

Official Correspondence

The University of Texas at Austin considers e-mail as an official mode of university correspondence: <https://cio.utexas.edu/policies/university-electronic-mail-student-notification-policy>. You are responsible for following course-related information on the Canvas site for the course.

University Honor Code

“The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, fairness, and respect toward peers and community.” <http://www.utexas.edu/about/mission-and-values>.

Religious Holy Days

A student who misses classes or other required activities, including examinations, for the observance of a religious holy day should inform the instructor as far in advance of the absence as possible so that arrangements can be made to complete an assignment within a reasonable period after the absence. A reasonable accommodation does not include substantial modification to academic standards, or adjustments of requirements essential to any program of instruction. Students and instructors who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the Office for Inclusion and Equity. The University does not maintain a list of religious holy days.

Absence for Military Service

In accordance with section 51.9111 of the Texas Education Code, a student is excused from attending classes or engaging in other required activities, including exams, if he or she is called to active military service of a reasonably brief duration. The maximum time for which the student may be excused has been defined by the Texas Higher Education Coordinating Board (THECB) as no more than 25 percent of the total number of class meetings or the contact hour equivalent (not including the final examination period) for the specific course or courses in which the student is currently enrolled at the beginning of the period of active military service. The student will be allowed a reasonable time after the absence to complete assignments and take exams. Policies affecting students who withdraw from the University for military service are given in the Withdrawal section.

Campus Carry

“The University of Texas at Austin is committed to providing a safe environment for students, employees, university affiliates, and visitors, and to respecting the right of individuals who are licensed to carry a handgun as permitted by Texas state law.” For more information, please see <http://campuscarry.utexas.edu/students>.

Safety Information

If you have concerns about the safety or behavior of students, TAs, Professors, or others, call the Behavioral Concerns Advice Line at 512-232-5050. Your call can be anonymous.

Students with Disabilities

UT provides upon request appropriate academic accommodations for qualified students with disabilities. Disabilities range from visual, hearing, and movement impairments to ADHD, psychological disorders (e.g. depression and bipolar disorder), and chronic health conditions (e.g. diabetes and cancer). These also include temporary disabilities such as broken bones and recovery from surgery. Services for Students with Disabilities is available at 512-471-6259 [voice], 866-329-3986 [video], ssd@uts.cc.utexas.edu, or <http://ddce.utexas.edu/disability>.

Mental Health Counseling

College can be stressful and sometimes we need a little help. Luckily, we have a wealth of

resources and dedicated people ready to assist you, and treatment does work. The Counseling and Mental Health Center (CMHC) provides counseling, psychiatric, consultation, and prevention services that facilitate student academic and life goals and enhance their personal growth and well-being. CMHC counselors are available Monday-Friday 8am-5pm 5th floor of the Student Services Building (SSB) in person and by phone (512-471-3515).

Alternatively, you can talk to Ms. Jeni Wade, LCSW right here in the College of Engineering. Ms. Wade is our Care Counselor and she can be reached at 512-471-8396. She has office hours in EER 2.848 for drop-ins.

If you are experiencing a mental health crisis (e.g. depression or anxiety), please call the Mental Health Center Crisis line at 512-471-CALL(2255). Call even if you aren't sure you're in a full-blown crisis, but sincerely need help. Staff are there to help you.

A wonderful resource is the MindBody Lab, a self-paced environment designed to help UT students explore various resources for improving their emotional and physical health. The Lab currently features audio and video instruction on a variety of topics, including sleep issues; food and body image; health and well-being; relaxation and meditation. Most of the material is experiential, enabling students to follow along and practice the skills as they are being discussed. MindBody Labs are located in SSB 5th floor, SAC 2.106 and NUR 3.156D.

Title IX Reporting

Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms where all students, faculty, and staff can learn, work, and thrive. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
3. Investigate and discipline violations of the university's relevant policies.

Faculty members and certain staff members are considered "Responsible Employees" or "Mandatory Reporters," which means that they are required to report violations of Title IX to the Title IX Coordinator at UT Austin. **I am a Responsible Employee and must report any Title IX related incidents** that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu. For more info about reporting options and resources, visit <https://titleix.utexas.edu/campus-resources> or contact the Title IX Office at titleix@austin.utexas.edu.