

Foundations of Digital Signal Processing

EEL 4750/5502

Class Periods: T | Period 2- 3 (8:30 AM – 10:25 AM)
R | Period 3 (9:35 AM – 10:25 AM)

Class Location: NEB 100

Academic Term: Fall 2018

Instructor

Name: Joel B. Harley

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Office Phone Number: 352-392-2692

Office Location: NEB 441

Office Hours: TR 10:30 AM – 11:30 AM, NEB 441

Teaching Assistants

Please contact through the Canvas website

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|------------------|--------------|-------------|-------------------|
| • Harsha Tetali, | Office: TBA, | E-mail: TBA | Office Hours: TBA |
| • Kang Yang, | Office: TBA, | E-mail: TBA | Office Hours: TBA |

Course Description

This course covers topics related to the foundations of digital signal processing. After completing this course, students should understand the essential properties of discrete-time signals and systems; understand the sampling and reconstruction of signals; be able to perform transform analysis of digital signals and systems, and apply filter design techniques; as well as understand the fundamental principles of multi-rate signal processing.

Course Pre-Requisites / Co-Requisites

Prerequisite: EEL 3135 (Introduction to Signals and Systems) or equivalent

Course Objectives

At the conclusion of this course, you should be able to:

- Apply discrete-time systems to discrete-time signals
- Explain aliasing caused by under-sampling data
- Apply convolution and correlation to modify and locate signals
- Design a system with the Z-transform
- Create a Fast Fourier transform algorithm
- Analyze data with the short-time Fourier transform / spectrogram
- Design FIR & IIR filters for modifying time-domain signals
- Analyze data with a multi-channel filter bank
- Apply linear prediction for optimal filtering
- Apply adaptive filters to address time-varying parameters
- Apply power spectrum estimation to improve time-frequency filtering and analysis

Recommended Materials

- Digital Signal Processing, 4th edition
 - Authors: John G. Proakis and Dimitris K. Manolakis
 - Publisher: Prentice Hall, 2006
 - ISBN: 0131873741
- EEL 4750/EEL 5525 Course notes
 - Author: Joel B. Harley

Recommended Software

- MATLAB (maybe Python)

Course Schedule

Date	Lecture	Text Chapters	HW Due	Code Due
Tue Aug 21	No class	--		
Thu Aug 23	Motivation, policies, DSP	1		
Tue Aug 28	Continuous-Time and Discrete-Time Signals	1, 2.1-2.2		
Thu Aug 30	Sampling and Aliasing	1.3, 6.1, 6.2, 6.4	HW 1	
Tue Sep 04	Quantization and Error	1.4, 6.3, 6.5, 6.6		
Thu Sep 06	Convolution and Correlation	2.2-2.6	HW 2	Code 1
Tue Sep 11	Discrete Systems and Diff. Equations	3		
Thu Sep 13	The Z-Transform	4	HW 3	
Tue Sep 18	The Discrete-Time Fourier Transform	4.3-4.3		
Thu Sep 20	Frequency Analysis	5	HW 4	Code 2
Tue Sep 25	Exam 1			
Thu Sep 27	The Discrete Fourier Transform	7		
Tue Oct 02	The Fast Fourier Transform	8		
Thu Oct 04	The Short-Time Fourier Transform	--	HW 5	Code 3
Tue Oct 09	Implementing Discrete-Time Systems	9		
Thu Oct 11	Designing Digital Filters: FIR	9.2, 10.1-10.2	HW 6	
Tue Oct 16	Designing Digital Filters: IIR	9.3, 10.3-10.4		
Thu Oct 18	Downsampling and Upsampling	11.1-11.3	HW 7	Code 4
Tue Oct 23	Resampling and Projections	11.4-11.8		
Thu Oct 25	Two-Channel Filter Banks	11.0-11.11	HW 8	
Tue Oct 30	Exam 2			
Thu Nov 01	Multi-Channel Filter Banks	11.12		Code 5
Tue Nov 06	Linear Prediction	12.1-12.4		
Thu Nov 08	Applications of Linear Prediction	12.5-12.7	HW 9	
Tue Nov 13	Adaptive Filters	13		
Thu Nov 15	Applications of Adaptive Filters	13	HW 10	Code 6
Tue Nov 20	Power Spectrum Estimation	14		
Thu Nov 22	Thanksgiving Break (no class)	--		
Tue Nov 27	Applications of Power Spectrum Estimation	14		
Thu Nov 29	Modern Signal Processing	--	HW 11	Code 7
Tue Dec 04	Exam 3			
Thu Dec 06	No class	--		
Wed Dec 12	Final Exam (7:30 AM – 9:30 AM)	--		

Attendance and Participation Policies

Attendance:

While attendance is not graded, lectures will include regular homework help and in-class discussions and demonstrations on the subject material.

Participation:

While participation is not graded, it is an integral part of each class that can help you learn the material.

Evaluation Methods and Criteria

The following section discusses the policies for each of the graded assessments in this course. You should look here first for answers to any general, course-related inquiries.

Homework (11 in total)

When: Assigned roughly once a week (see course schedule on website).

What: Analytical problems that can be solved by hand.

Why: Homework is intended to guide you through course material and present you with questions that will require time to think about and complete (unlike quiz or exam questions). Homework assignments are not meant to be completed in a single day.

Grading: Homework is graded on a scale from 0 to 3. The meaning of each grade is:

3.0: > 75% correct	2.5: 65% - 75% correct
2.0: 55% - 65% correct	1.5: 45% - 55% correct
1.0: 35% - 45% correct	0.5: 25% - 35% correct
0.0: 00% - 25% correct	

Late policy: Late assignments will not be eligible for $(0.5)x$ points, where x is the number of weekdays late, for up to 2 weekdays. For example, if you receive a 2.5 and submit the assignment 2 weekdays late, the final grade will be a $2.5 - 1 = 1.5$. After 2 weekdays, the homework is assigned a 0.

Submission: Homework will be submitted on canvas before midnight (11:59 PM) on the due date. Please ensure that your submission is readable.

Coding Problems (7 in total)

When: Occur roughly once every two weeks (see course schedule at the end of the syllabus).

What: One to three MATLAB (maybe python) problems to complete

Why: These problems are intended to give you more hands-on, practical experience with digital signal processing and how it is used to solve various engineering problems

Grading: Coding problems are graded on a 20-point scale. Of the 7 assignments, only the highest scoring 6 will count toward the final grade. Unreadable answers will be considered incorrect.

Late policy: Late assignments will not be eligible for $2x$ points, where x is the number of weekdays late, for up to 10 weekdays.

Submission: Coding solutions will be submitted on canvas before midnight (11:59 PM) on the due date. Please ensure that your submission is can be run without any additional materials.

Exams (3 in total)

When: There are three non-cumulative exams covering each part of the course and one cumulative final exam.

What: Questions will be similar to homework but generally a little shorter and require less time to think

Why: Exams are an opportunity to show what you know about signals and systems.

Cheat sheets for Exam 1 & 2 & 3: *one* double-sided 8.5 by 11 inches (or smaller) cheat sheet allowed.

Cheat sheets for Final exam: *three* double-sided 8.5 by 11 inches (or smaller) cheat sheets allowed.

Grading: Exams are graded on a 100-percentage scale.

Makeup exams: Each part of the final exam acts as a re-take or make-up exam. If you perform poorly on an exam, you will have the opportunity to take one or more final exam parts to replace your grade(s). You will receive the highest grade from each midterm/final part pair.

In-Depth Report (EEL 5502 only)

When: There will be one in-depth report that is due at the end of course

What: The report will generally discuss a recent advance in digital signal processing. Topics will be based on the [top articles from the IEEE Signal Processing Magazine](#) (or similar location) and must be less than 10 years old. All topics will be approved by me.

Why: The report demonstrates your ability to dive deeper into a topic

Grading: The reports are graded on a 100-percentage scale.

Evaluation of Grades

Assignment	Percentage of Final Grade (EEL 4750)	Percentage of Final Grade (EEL 5502)
Homework Sets (best 10 out of 11)	20%	15%
Code Problems (best 6 out of 7)	20%	15%
Midterm Exam 1	20%	20%
Midterm Exam 2	20%	20%
Midterm Exam 3	20%	20%
Final Exam	See section on exams	See section on exams
In-Depth Report	--	10%
	100%	100%

Grading Policy

Percent	Grade	Grade Points
93.3 - 100.0	A	4.00
90.0 - 93.3	A-	3.67
86.6 - 90.0	B+	3.33
83.3 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.6 - 80.0	C+	2.33
73.3 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.6 - 70.0	D+	1.33
63.3 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
00.0 - 60.0	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Course & University Policies

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.