Digital Signal Processing (Lab)

EE/CE 453L/352L T1
Spring Semester 2025

"*Distinguishing the signal from the noise requires both scientific knowledge and self-knowledge*." - Nate Silver

Course Information

Start Date	End Date	Class Location	Meeting Time
Jan 06 2025	Apr 25 2025	W-110	Mon (09:40 AM-12:40 PM)

Hardware/Software Prerequisites: Computer or laptop with internet access, word processing, presentation creator and MATLAB with Digital Signal Processing Toolkit.
Content Area: This course meets requirements for CE core and EE elective.

Instructor Information

Instructor: Shafayat Abrar
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Office Hours: TBA

Instructor: Ahmad Bilal
Office Location: TBA
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Office Hours: TBA

Course Description

The explosion of digital data in today's world has made it crucial that students understand techniques for processing digital signals being generated from a wide variety of sources. This course addresses this need by covering basic concepts of digital signal processing (DSP) such as sampling, reconstruction and aliasing, fundamental filtering algorithms, and software implementation of DSP algorithms. Modern DSP applications include biomedical, communications, speech, multimedia, and financial signal processing.

Course Aims

The objective of this course is to provide a basic introduction to the theory of digital signal processing (DSP). Major parts of the course will concentrate on discrete-time signal and systems analysis in time and frequency domains, digital filter structures, and digital filter design.

We will study the discrete Fourier transform and its properties. We will also study the sampling theorem and the relationship between continuous and discrete-time transforms. We will see how discrete-time, linear shift-invariant systems can be characterized using linear difference equations and the impulse response and show how tools such as the z-transform and discrete Fourier transform can be used in the design and analysis of such systems. We will then study the design and implementation of digital filters. While this course deals largely with the theory of DSP, we will use MATLAB, to look at applications of this theory, particularly Fourier analysis and digital filter design.

Course Learning Outcomes (CLOs)

By the end of the course, students will be able to:

CLO	Description	Learning Domain Level

CLO 1	Analyze discrete-time signals and systems in time domain	Cog-4
CLO 2	Analyze discrete-time signals and systems in transform domain using z-Transform, DTFT, and DFT	Cog-4
CLO 3	Design various types of digital filters to meet given specifications	Cog-5
CLO 4	Apply appropriate digital signal processing techniques to an adequately-explained domain-specific scenario	Cog-4

Mode of Instruction

The course consists of two 75-minute lectures per week. The material in each class will build up on the previous classes. If you miss a class, you'll be responsible for catching up.

There will be 4 homework assignments. You are allowed to consult with each other on homework assignments. However, the solution submitted must be written in your own words and must not be a copy of some other student's submission.

There will be a total of 4 quizzes for this course. You are not allowed to consult with each other during quizzes.

All course presentations, recorded sessions, lecture slides, and all other support material will be managed within a dedicated LMS site.

Number of hours required for offline work: Students can expect to work for at least twice as many hours per week outside of the scheduled class for this course.

Engagement & Participation Rules

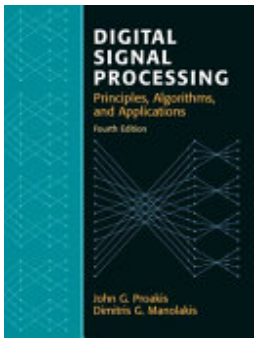
I encourage you all to ask questions and stop me if you are having trouble understanding something. If you're confused by something but hesitant about bringing attention to yourself, I want to assure you that you're not alone and there are most likely other students feeling the same as you.

There will be multiple engagement opportunities during the course. You are expected to participate in all of these activities to maximize your learning.

Finally, I expect that you'll be respectful to each other always.

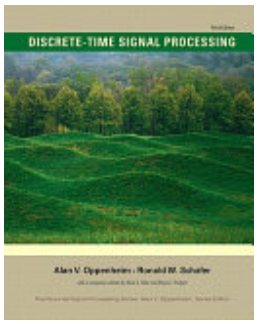
Required Texts and Materials

Digital Signal Processing
Edition: 4th

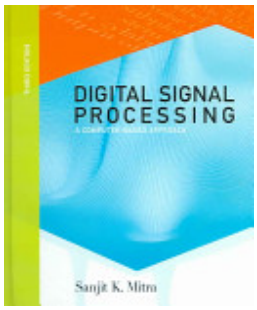


Authors: John G. Proakis, Dimitris G. Manolakis
Publisher: Pearson
Publication Date: 2007-01-01

Optional Materials



Discrete-time Signal Processing
Edition: 3rd
Authors: Alan V. Oppenheim, Ronald W. Schafer
Publisher: Prentice Hall
Publication Date: 2010-01-01



Digital Signal Processing
ISBN: 9780072865462
Authors: Sanjit Kumar Mitra
Publisher: McGraw-Hill Companies
Publication Date: 2006-01-01

Assessments

Assessment Type	Total	Weight	Remarks
Quizzes	4	25%	Usually 30 to 40 minutes long.
Homework	3	15%	You are allowed to consult with each other on homework assignments. However, the solution submitted must be written in your own words and must not be a copy of some other student’s submission.
Mid-term Exam	1	20%	Format will be released later.
Report and	1	10%	Format will be released later.

Presentation			
Final Exam	1	30%	Format will be released later.

Grading Scale

Letter Grade	GPA Points	Percentage
A+	4.00	[95-100]
A	4.00	[90-95)
A-	3.67	[85-90)
B+	3.33	[80-85)
B	3.00	[75-80)
B-	2.67	[70-75)
C+	2.33	[67-70)
C	2.00	[63-67)
C-	1.67	[60-63)
F	0.00	[0, 60]

Note: [a, b) is a range of numbers from a to b where a is included in the range and b is not.

Late Submission Policy

Students are expected to submit all the assignments at the specified time. **No late submission of HW assignment is allowed,** because a solution for these HW assignments will be posted at the time of submission deadline. This policy will be followed strictly.

Week-Wise Schedule (Tentative)

Week	Tentative Topics	Assessment Released	Assessment Due
1	Introduction to digital signal processing, discrete-time signals and their properties, elementary operations on discrete-time signals.		
2	Discrete-time systems (convolution and difference equations)	HW 1	
3	Discrete-time systems (properties and forms)	Quiz 1	HW 1
4	Discrete time Fourier Transform (DTFT)	HW 2	
5	Z-transform		

6	Discrete Fourier Transform (DFT) & Fast Fourier Transform (FFT)		HW 2
7	Introducing to analog filters	Quiz 2	
8	Digital filter structures	Midterm	
9	Digital filter design (FIR)	HW 3	
10	Digital filter design (IIR)		HW 3
11	Multi-rate Signal Processing	Quiz 3	
12	Discrete-time random processes	Report	
13	Applications of DSP	Quiz 4	
14	Applications of DSP		Report
15	Extra Topics and Presentations		Presentation

Attendance Policy

Students are expected to maintain 100% attendance in the courses at HU. However, all students must maintain class attendance per the attendance threshold document shared by the RO to deal with any unforeseen situations at your end during the semester. If one cannot participate in any session, inform the instructor within 24 hours with a reason. Noncompliance will eventually lead to withdrawing/failing the student(s) from this course. Attendance will be marked manually in the class per the University's attendance policy.

Final Exam Policy

The end-term exam will be held during the exam week of the semester. The details of the exam will be shared well before the final date.

Academic Integrity

Each student in this course is expected to abide by the Habib University Student Honor Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work.

Scholastic dishonesty shall be considered a serious violation of these rules and regulations and is subject to strict disciplinary action as prescribed by Habib University regulations and policies. Scholastic dishonesty includes, but is not limited to, cheating on exams, plagiarism on assignments, and collusion.

a. Plagiarism: Plagiarism is the act of taking the work created by another person or entity and presenting it as one’s own for the purpose of personal gain or of obtaining academic credit. As per University policy, plagiarism includes the submission of or incorporation of the work of others without acknowledging its provenance or giving due credit according to established academic practices. This includes the submission of material that has been appropriated,// bought, received as a gift, downloaded, or obtained by any other means. Students must not, unless they have been granted permission from all faculty members concerned, submit the same assignment or project for academic credit for different courses.
b. Cheating: The term cheating shall refer to the use of or obtaining of unauthorized information in order to obtain personal benefit or academic credit.
c. Collusion: Collusion is the act of providing unauthorized assistance to one or more person or of not taking the appropriate precautions against doing so.

All violations of academic integrity will also be immediately reported to the Student Conduct Office.

You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy.

Should copying occur, the student who copied work from another student and the student who gave material to be copied will both be in violation of the Student Code of Conduct.

If you wish to use generative-AI tools to complete any of your assessments, you must first obtain permission from your course instructor. AI generated work will not be accepted in all classes or even all assessments. The instructor's permission is required. If the permission is granted, you should declare its use and properly cite the source of the generated content. Failing to identify AI written or assisted work is academic dishonesty and will be treated as any case of plagiarism by the university.

The principle for academic integrity is that your submissions must be substantially your own work and that any work that is not originally your thought must be identified and credited. If the use of AI tools is prohibited in the course, respect the rules and do not use these tools for assessments. The fundamental purpose of assessment is to learn, synthesize information and explain new connections and interpretations that arise from your secondary research. Be aware that unauthorized use of AI tools for assessments can result in a conduct case being filed. This can have serious consequences for your academic standing and future career opportunities.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

Program Learning Outcomes (For Administrative Review)

Upon graduation, students will have the following abilities:

- PLO 1: Engineering Knowledge: An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
- PLO 2: Problem Analysis: An ability to identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- PLO 3: Design/Development of Solutions: An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

Program Learning Outcomes (PLOs) mapped to Course Learning Outcomes (CLOs)				
	CLOs of the course are designed to cater following PLOs: PLO 1: Engineering Knowledge PLO 2: Problem Analysis PLO 3: Design/Development of Solutions			
	Distribution of CLO weightages for each PLO			
	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**
PLO 1				100%
PLO 2	50%	50%		
PLO 3			100%	

Mapping of Assessments to CLOs

Assignments	**CLO #01**	**CLO #02**	**CLO #03**	**CLO #04**
Homework 1	x			
Homework 2		x		
Homework 3			x	

Homework 4				x
Quiz 1	x			
Quiz 2	x	x		
Quiz 3		x	x	
Quiz 4			x	x
Midterm	x	x	x	x
Endterm	x	x	x	x

Recording Policy

Only asynchronous and synchronous online sessions will be conducted and recorded via MS Teams. Link to the recordings will be available to all students on Canvas Learning Management System.

Accommodations for Students with Disabilities

In compliance with the Habib University policy and equal access laws, I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with the Office of Academic Performance to verify their eligibility for appropriate accommodations.

Inclusivity Statement

We understand that our members represent a rich variety of backgrounds and perspectives. Habib University is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value each other’s opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create an inclusive environment in this course and across the Habib community

Office Hours Policy

Every student enrolled in this course must meet individually with the course instructor during course office hours at least once during the semester. The first meeting should happen within the first five weeks of the semester but must occur before midterms. Any student who does not meet with the instructor may face a grade reduction or other penalties at the discretion of the instructor and will have an academic hold placed by the Registrar’s Office.