COURSE SYLLABUS

1 ECE 3225 - Signal Processing

2 Meeting Information

3 credits, 3 contact hours MWF 11:30-12:20

a. **Section 001:**
Lecture: MWF from 11:30 am to 12:20 pm, **Tolentine Hall 417**

3 Course Instructor(s), TA(s)

a. **Section 001:**

Class Instructor:	Dr. Mojtaba Vaezi
Office Hours:	MW from 10:30 am to 11:20 am, or by appt.
TA(s):	
Xinliang Zhang	xzhang4@villanova.edu
Office Hours:	Friday 2:30-4:30 pm, or by appt.

4 Textbook

Fawwaz T. Ulaby and Andrew E. Yagle, Signals and Systems: Theory and Applications, 2018, `http://ss2.eecs.umich.edu` . REQUIRED.

a. **Other Supplemental Materials:**
1. Oppenheim & Willsky, *Signals & Systems*, 2nd ed., Prentice-Hall, 1997.
2. Hsu, *Schaum's Outline of Signals & Systems*, McGraw Hill, 1995.

5 Specific Course Information

a. **Catalog Description**
Signal representation, Fourier series, Fourier transform, discrete-time systems, convolution, discrete-time Fourier transform, Z-transform. Practicum includes MATLAB exercises on transform properties and their use in modulation and filtering.

b. **Prerequisites:** ECE 2030 and ECE 2409 and MAT 2705; **Co-requisites:** ECE 3230

c. Required for BS EE

6 Course-specific Goals

a. This course introduces the theory and practice of continuous-time and discrete-time signals & systems analysis. Topics covered are signal representation and classifications, system representation and properties, linear time-invariant systems, convolution, various Fourier transforms, Laplace and z transforms, sampling, filtering and modulation. Application examples and computer implementations (in Signals Lab) will constitute an integral part of the learning process.

b.

ABET Student Outcomes						
1	2	3	4	5	6	7
X						

The above student outcomes are defined by the Accreditation Board for Engineering and Technology (ABET) as:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

7 List of Covered Topics

1. **Chapter 1: Signals**
2. 1-1 Types of Signals
3. 1-2 Signal Transformations
4. 1-3 Waveform Properties
5. 1-4 Nonperiodic Waveforms
6. 1-5 Signal Power and Energy
7. **Chapter 2: Linear Time-Invariant (LTI) Systems**
8. 2-1 Linear Time-Invariant Systems
9. 2-2 Impulse Response
10. 2-3 Convolution
11. 2-4 Graphical Convolution
12. 2-5 Convolution Properties
13. 2-6 Causality and BIBO Stability
14. 2-7 LTI Sinusoidal Response
15. **Chapter 5: Fourier Analysis Techniques**
16. 5-2 Fourier Series Analysis Technique
17. 5-3 Fourier Series Representations
18. 5-4 Computation of Fourier Series Coefficients
19. 5-5 Circuit Analysis with Fourier Series
20. 5-6 Parseval's Theorem for Periodic Waveforms
21. 5-7 Fourier Transform
22. 5-8 Fourier Transform Properties
23. 5-9 Parseval's Theorem for Fourier Transforms
24. 5-12 Circuit Analysis with Fourier Transform
25. **Chapter 6: Applications of the Fourier Transform**
26. 6-1 Filtering
27. 6-12 Modulation
28. 6-13 Sampling Theorem
29. **Chapter 7: Discrete-Time Signals and Systems**
30. 7-1 Discrete Signal Notation and Properties
31. 7-2 Discrete-Time Signal Functions
32. 7-3 Discrete-Time LTI Systems
33. 7-4 Properties of Discrete-Time LTI Systems

34. 7-5 Discrete-Time Convolution
35. 7-6 The z-Transform
36. 7-7 Properties of the z-Transform
37. 7-8 Inverse z-Transform
38. 7-10 System Transfer Function
39. 7-12 System Frequency Response
40. 7-14 Discrete-Time Fourier Transform (DTFT)
41. 7-15 Discrete Fourier Transform (DFT)
42. 7-16 Fast Fourier Transform (FFT)

8 Tentative Schedule

Tentative schedules for all sections follow. Be sure to refer to the schedule for your specific section, if more than one is provided.

Tentative Schedule for **All Sections**

Date	Day	Topics	Reading	Due
8/23	M	Introduction		
8/25	W	Complex numbers/Math formulas	Appendices B, C	
8/27	F	Types of Signals	Section 1.1	
8/30	M	Signal Transformations	Section 1.2	HW1
9/1	W	Signal Transformations	Section 1.2	
9/3	F	Waveform Properties	Section 1.3	
9/6	M	**Labor Day - No Class**		
9/8	W	Nonperiodic Waveforms	Section 1.4	
9/10	F	Nonperiodic Waveforms	Section 1.4	
9/13	M	Signal Power and Energy	Section 1.5	
9/15	W	Chapter Summary/Problem Solving		HW2
9/17	F	Test 1 (Chapter 1)	Chapter 1	
9/20	M	LTI Systems	Section 2.1	
9/22	W	Impulse Response	Section 2.2	
9/24	F	Convolution	Section 2.3	
9/27	M	Graphical Convolution	Section 2.4	
9/29	W	Convolution Properties	Section 2.5	
10/1	F	Problem Solving		
10/4	M	Causality and BIBO Stability	Section 2.6	HW3
10/6	W	Causality and BIBO Stability	Section 2.6	
10/8	F	LTI Sinusoidal Response	Section 2.7	
10/11	M	**Semester Recess**		
10/13	W	**Semester Recess**		
10/15	F	**Semester Recess**		
10/18	M	Chapter Summary	Chapter 2	HW4
10/20	W	Test 2 (Chapter 2)	Chapter 2	
10/22	F	Fourier Series	Section 5.2	
10/25	M	Fourier Series	Section 5.2	
10/27	W	Fourier Transform	Section 5.4	
10/29	F	Fourier Transform Applications	Section 5.7	
11/1	M	Fourier Transform Applications	Chapter 6	
11/3	W	Problem Solving	Chapter 5, 6	HW5
11/5	F	Discrete-Time Signals	Section 7.1	
11/8	M	Test 3 (Chapters 5 and 6)		
11/10	W	DT Signal Functions	Section 7.2	
11/12	F	DT LTI Systems	Section 7.3	
11/15	M	Properties of DT LTI Systems	Section 7.4	
11/17	W	DT Convolution	Section 7.4	
11/19	F	DT Convolution Properties	Section 7.5	
11/22	M	The z-Transform	Section 7.6	HW6
11/24	W	**Thanksgiving break**		
11/26	F	**Thanksgiving break**		
11/29	M	System Transfer Function	Section 7.10	
12/1	W	System Frequency Response	Section 7.12	
12/3	F	Discrete-Time Fourier Transform	Section 7.14	
12/6	M	Discrete Fourier Transform (DFT)	Section 7.15	HW7
12/8	W	Chapter Summary		
12/11	S	Final Exam	10:45 AM - 01:15 PM	

9 Grading Policy

	Weight	Remarks
Homework	20%	7 homework (due in 1 week)
Test 1	15%	Chapter 1, Friday, September 17, 2021
Test 2	20%	Chapter 2, Wednesday, October 20, 2021
Test 3	15%	Chapters 5 &6, Monday, November 8, 2021
Test 4 (Final)	20%	Chapter 7, Saturday December 11, 2021
Quizzes/Participation	10%	Kahoot! quizzes (about 10 quizzes)

Participation in quizzes will account for 8% and only 2% is for the answers.

Letter grade scale: A(93–100), 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(63–66), D–(60–62), F(<60)

10 HW Assignment and Laboratory Report Submission Policy

- Homework sets are due one week after submission, by 11 pm. All assignments should be uploaded in the Blackboard as a single file (preferably a PDF file)
- There will be 25% penalty for late assignments. No assignment will be accepted after solutions are posted.
- You are welcome and even encouraged to discuss with other students about the homework, but everyone should turn in their own write-up.
- When submitting your assignments, please make sure that answers are in order and the solutions are neat and readable.

Effective study habits: Attend the lectures, take notes, ask questions, study in group, do the homework, and attempt the examples (solved or unsolved) of the textbook.

11 Attendance Policy

Attendance in class is mandatory. Students who do not attend or miss the quizzes will lose the attendance mark.

Whenever possible, students should inform the instructor if they plan to be late or absent from class. In all cases, documentation is required to petition for *excused* absences to the Associate Dean for Student and Strategic Programs, Dr. Stephen Jones. The excused absence form is posted at: https://www1.villanova.edu/villanova/engineering/resources/undergraduates.html.

Excused absences do not count towards a failure in the course for first year students. Absence from class does not release the student from assigned work. Students who miss an in-class obligation such as an exam, a presentation, etc., due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing a class. The University's list of excused absences for all students includes the following:

1. Participation in NCAA athletic competitions
2. Participation in special academic events such as: conferences, field trips, project competitions, etc., and in official university business such as student representatives attending meetings related to university governance

3. Attendance at significant events of the immediate family such as: funerals, weddings, etc.
4. Religious holidays - see the University's policy on Religious Holidays
5. College-approved participation in placement activities such as: job interviews, graduate school interviews, job fairs
6. Legally required absence such as: jury duty, court appearance, short-term military service
7. Documented serious illness or disability

12 Examination Policy

The College of Engineering has adopted the following general examination guidelines:

1. Students must arrive before the start of the examination. Under exceptional circumstances a student may need to arrive late, but he/she can enter the examination room no later than five (5) minutes after the start of the exam.
2. Cell phones must be turned off until the student exits the examination room.
3. The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an examination.
4. Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this examination."
5. For online examinations, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will inform students in advance if (s)he plans to use any form of video-proctoring and whether the examination will be recorded.

13 Academic Integrity Policy

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. The University's academic integrity policy can be found on the following web page:
https://www1.villanova.edu/villanova/provost/resources/student/policies/integrity.html.

14 Adherence to the Student Code of Conduct

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to university regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

15 Online Expectations

To foster a professional environment, please wear appropriate clothes, mute if you are not talking to cut down on background noise, refrain from eating, and select an appropriate setting when we are meeting online.

16 Inclusive Classroom

This classroom is a place where you will be treated with respect; we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment to allow all among us to learn and flourish.

17 Students with Disabilities

It is the policy of the university to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with the office of Learning Support Services (LSS) by emailing Learning.support.services@villanova.edu or by phoning 610-519-5176 as soon as possible. Registration is *required* in order to receive accommodations.

The Office of Disability Services (ODS) collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities at 610-519-3209 or visit the office on the second floor of the Connelly Center.

18 Tutoring Services

Villanova's tutoring services include The Writing Center, The Learner's Studio, and The Center for Speaking and Presentation. These services are offered free of charge to students. Drop in as-needed or book a regular weekly session to supercharge your academic success. Sessions can be 30 or 60 minutes in length.

Register for an account and book sessions in advance at villanova.mywconline.com. If you don't see your class listed, request a tutor for a missing subject at: tutorrequest.villanova.edu For more information, contact Juliana Struder at juliana.studer@villanova.edu or at 610-519-5862.

19 Electronics Policy

The use of electronic devices, such as phones, laptops, tablets, calculators, etc., during class is generally allowed, unless their use causes a disturbance to others. During examinations, the use of any electronic device is prohibited, unless it is expressly authorized by the instructor.

Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in

advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course, and may not disseminate or share them with a wider audience without explicit permission.

20 Copyright Policy

The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the university which may not be disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, slides, etc., provided by a course instructor. Course materials may only be used by students enrolled in the course for academic (course-related) purposes.

Published course readings (book chapters, articles, reports, etc.) available in "Blackboard" are copyrighted materials. These works are made available to students through licensed databases or fair use. They are protected by copyright law, and may not be further disseminated or reproduced in any form for distribution (e.g. uploading to websites, sale, exchange, etc.) without the permission of the copyright owner.

Follow these links for more information on Intellectual Property, Copyright, and Computer Acceptable Use.

21 Professorial Duties

It is important to note that teaching is one of the many duties that professors perform as part of their job responsibilities. In addition to teaching, professors perform research, advise graduate students, edit journals and review journal articles, serve on committees for the university and professional societies, travel to conferences to remain abreast of current developments and to present their results... to name just a few commitments.