

# ECE 201 – Introduction to Signals and Systems

George Mason University

Spring 2023

**In-person class meetings:** January 24 – May 4, 2023; **Final exam:** May 16, 2023

- Tuesdays and Thursdays, 10:30 am - 11:45 am in Enterprise Hall, Room 80

**Instructor:** Brian L. Mark, Dept. of Electrical and Computer Engineering

office: ENGR 3220    email: bmark [at] gmu.edu    phone: 703-993-4069

office hours: Wed., 1 - 2:30 pm (in-person) and by appointment (in-person or via Zoom)

## Graduate Teaching Assistants:

Ankit Pawaskar (email: apawaska [at] gmu.edu)

office hrs: Tue., 12 - 2 pm; Wed. 2:30 - 4:30 pm in ENGR 3208

Sai Kosuri (email: skosuri2 [at] gmu.edu)

office hrs: Wed., 4 - 6 pm; Fri. 12 - 2 pm in ENGR 3204

**Course Description:** This course provides an introduction to key concepts of signals and systems with an emphasis on discrete-time signals and systems. Specific topics include sinusoidal and complex exponential signals, sampling, spectrum representation of signals via discrete-time Fourier Transform (DTFT) and discrete Fourier transform (DFT), system properties, convolution, impulse response and frequency response. The associated computer lab provides opportunities to apply the theory to real-world scenarios.

**Course Website:** Log in to your Blackboard account at: [mymasonportal.gmu.edu](http://mymasonportal.gmu.edu)

**Course Objectives:** Upon completion of the course, students should be able to

1. Analyze plots of sinusoidal signals to determine amplitude, frequency, and phase.
2. Calculate the sum of sinusoidal signals using complex exponentials.
3. Compute the spectrum of selected signals and perform simple operations in the frequency domain.
4. Explain why the Nyquist condition ensures that sampled signals can be faithfully reconstructed into continuous-time signals.
5. Analyze systems to determine if they are causal, linear, or time-invariant.
6. Determine the impulse response of linear, time-invariant systems and compute the output of a system by convolving the input signal with the impulse response.
7. Calculate the frequency response of an LTI system from its impulse response.
8. Compute the discrete-time Fourier transform (DTFT), discrete Fourier transform (DFT), and z-transform for a selected set of signals.

## Required Textbook:

- J.H. McClellan, R.W. Schafer, and Mark A. Yoder, *DSP First - Second Edition*, Pearson, 2016.

## Course-specific Software:

- This course uses MATLAB, which can be obtained by logging into the following portal with your Mason credentials:

[www.mathworks.com/academia/tah-portal/george-mason-university-31483444.html](http://www.mathworks.com/academia/tah-portal/george-mason-university-31483444.html)

**Grading:** See p. 3 for further details

- Participation = 10%, Homework = 10%, Lab = 20%
- Quizzes = 5%, Two Midterm Exams = 30%, Final Exam = 25%.

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**Note:** The material provided in the course is proprietary. Uploading this material anywhere without the express permission of the instructor is strictly prohibited and a violation of the Mason Honor Code (see: [oai.gmu.edu](http://oai.gmu.edu)).

**Course Schedule: Week 1 – Week 9**

<b>Weeks</b>	<b>Topics</b>	<b>Assignments</b>
Week 1: 1/24, 1/26	Introduction	<ul style="list-style-type: none"> <li>• Read MSY: App. A and Chap. 1</li> <li>• Take Quiz 1 in class on Thursday</li> <li>• Start HW 1</li> </ul>
Week 2: 1/31, 2/2	Sinusoidal signals and complex exponentials	<ul style="list-style-type: none"> <li>• Read MSY: App. A, Chap. 2 through Sect. 2.4</li> <li>• Take Quiz 2 on Tuesday</li> <li>• Submit HW1 on Thursday</li> <li>• Start HW2</li> </ul>
Week 3: 2/7, 2/9	Phasor addition	<ul style="list-style-type: none"> <li>• Start Week 2 Discussion Post</li> <li>• Read MSY: Chap. 2 through Sect. 2.6</li> <li>• Take Quiz 3 on Tuesday</li> <li>• Submit HW2 on Thursday</li> <li>• Submit Week 2 Discussion Post on Friday</li> <li>• Start HW3</li> </ul>
Week 4: 2/14, 2/16	Frequency domain representation	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 3 through Sect. 3.2</li> <li>• Respond to a Week 2 Discussion Post on Monday</li> <li>• Take Quiz 4 on Tuesday</li> <li>• Submit HW3 on Thursday</li> <li>• Start HW4</li> </ul>
Week 5: 2/21, 2/23	Operations on spectrum	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 3               <ul style="list-style-type: none"> <li>◦ Operations on spectrum: Sect. 3.3</li> <li>◦ Periodic signals, Fourier series: Sect. 3.4–3.5</li> <li>◦ Time-frequency spectrum, Chirps: Sect. 3.6, 3.7</li> </ul> </li> <li>• Take Quiz 5 on Tuesday</li> <li>• Submit HW4 on Thursday</li> <li>• Start HW5</li> </ul>
Week 6: 2/28, 3/2	Sampling and aliasing due to undersampling	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 4, Sect. 4.1–4.2</li> <li>• Take Quiz 6 on Tuesday</li> <li>• Submit HW5 on Thursday</li> <li>• Start HW6</li> <li>• Start Week 6 Discussion Post</li> </ul>
Week 7: 3/7, 3/9	Nyquist sampling theorem and reconstruction	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 4, Sect. 4.3</li> <li>• Take Quiz 7 in class on Tuesday</li> <li>• Submit HW6 in class on Thursday</li> <li>• Submit Week 6 Discussion Post on Friday</li> <li>• Start HW7</li> </ul>
<b>SPRING BREAK</b>		

**Course Schedule:** Week 9 – Week 14, Final Exam

<b>Weeks</b>	<b>Topics</b>	<b>Assignments</b>
Week 8: 3/21, 3/23	Systems and their properties	<ul style="list-style-type: none"> <li>• <b>Midterm Exam 1</b> on Tuesday</li> <li>• Respond to a Week 6 Discussion Post on Monday</li> <li>• Read MSY: Chap. 5, through Sect. 5.3</li> <li>• No Quiz this week</li> <li>• Submit HW7 in class on Friday</li> <li>• Start HW8</li> </ul>
Week 9: 3/28, 3/30	Linear, time-invariant systems	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 5, Sect. 5.6 – 5.8</li> <li>• Take Quiz 9 on Tuesday</li> <li>• Submit HW8 on Thursday</li> <li>• Start HW9</li> </ul>
Week 10: 4/4, 4/6	FIR filters	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 5, Sect. 5.3, 5.4, 5.9</li> <li>• Take Quiz 10 on Tuesday</li> <li>• Submit HW9 on Thursday</li> <li>• Start HW10</li> </ul>
Week 11: 4/11, 4/13	Filtering in the frequency domain	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 6, Sect. 6.1, 6.5</li> <li>• Take Quiz 11 on Tuesday</li> <li>• Submit HW10 on Thursday</li> <li>• Start HW11</li> </ul>
Week 12: 4/18, 4/20	Frequency response of LTI systems	<ul style="list-style-type: none"> <li>• Read MSY: Chap. 6 (all sections)</li> <li>• Take Quiz 12 on Tuesday</li> <li>• Submit HW11 on Thursday</li> <li>• Start HW12</li> </ul>
Week 13: 4/25, 4/27	Transforms and DTFT	<ul style="list-style-type: none"> <li>• <b>Midterm Exam 2</b> on Tuesday</li> <li>• Read MSY: Chap. 7, Sect. 7.1–7.3</li> <li>• No Quiz this week</li> <li>• Submit HW12 on Thursday</li> <li>• Start HW13</li> </ul>
Week 14: 5/2, 5/4	$z$ -transform and DFT	<ul style="list-style-type: none"> <li>• Read MSY: <ul style="list-style-type: none"> <li>◦ <math>z</math>-transform: Chap. 9, Sect. 9.1–9.4, 9.5–9.6</li> <li>◦ DFT: Chap. 8, through Sect. 8.4</li> </ul> </li> <li>• Submit HW13 on Thursday</li> <li>• No new assignment</li> </ul>
May 16		<b>Final Exam</b> from 10:30 am to 1:15 pm (in class)

**Graded Course Components:**

- **Participation – 10%:** Attendance is required and will be recorded. You are expected to be an active participant during class. The frequency and quality of your contributions will be evaluated.
- **Weekly Homework – 10%:** Each week HW assignments are to be submitted in hard copy at the beginning of class on Thursdays. Assignments will usually consist of problems from the textbook or variations of them. Occasionally, assignments may include other activities such as posting to the discussion board or performing and documenting research. Assignments to be submitted as a PDF file on Blackboard by 11:59 pm on Thursday unless otherwise stated.

- **Lab – 20%:** Your score in the associated lab class will be factored into your final grade.
- **Quizzes – 5%:** Short quizzes will be given in class on a weekly basis via Blackboard and are intended to ensure that you are keeping up with the course material.
- **Midterm Exams (2) – 15% each:** Two in-class midterm exams, each 75 minutes in duration, will be given. The exams will contain problems similar to those on the weekly HW assignments or the example problems introduced in lectures. Midterm exams are not comprehensive and will include only material since the start of the semester or the previous exam, respectively.
- **Final Exam – 25%:** The final exam is comprehensive and 165 minutes in duration. The format is similar to the midterm exams.

**Student disability:** If you are a student with a disability and you need academic accommodations please let me know as soon as possible and contact the Office of Disability Services (ODS) at 703.993.2474, email: [ods\[at\]gmu.edu](mailto:ods[at]gmu.edu). All academic accommodations must be arranged through that office. Students must inform the instructor at the beginning of the semester, and the specific accommodation will be arranged through ODS.

**Academic Integrity:** GMU is an Honor Code university.

- **Mason Honor Code:** *To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.*
- Please review the full description of the code and the honor committee process at the Office of Academic Integrity website: [oai.gmu.edu](http://oai.gmu.edu).
- The Mason Honor Code requires that faculty submit any suspected Honor Code violations to the Honor Committee for adjudication.

**Late Assignment Policy:** In general, late assignment submissions will not be accepted without a valid reason, which should be communicated to the instructor in advance if possible. The lowest two homework assignment grades will be dropped.

**Attendance Policy:** Attendance will be recorded and will be factored into the Participation grade. Please let the instructor know if you will be absent for a class if possible. Absences may be excused for certain medical or other reasons at the discretion of the instructor.

## University Resources for Students

### **WAVES: Wellness, Alcohol and Violence Education and Services**

WAVES promotes wellness within the Mason community through health education, alcohol/drug assessment and education, and violence awareness, prevention and sexual assault response. We help students make healthy, safe choices and encourage lifelong, thoughtful healthy decision-making through individualized support, creative programming, and evidence-based education and outreach.

**WAVES office 703-993-9999**

**SUB I, Suite 3200**

**24-Hour Sexual and Intimate Partner Violence Crisis Line 703-380-1434**

**waves.gmu.edu**

- 703-360-7273 (Fairfax County Office for Women and Domestic and Sexual Violence Services 25 hotline)
- 703- 228-4848 (Arlington County Domestic Violence Services Hotline)
- 703-368-4141 (Prince William County Sexual Assault Victims Advocacy Services (SAVAS) hotline)
- 1-800-838-8238 (Virginia Family Violence and Sexual Assault Hotline)
- 1-800-656-HOPE (Rape, Abuse and Incest National Network)  
<https://ohl.rainn.org/online/>

### **CAPS: Counseling and Psychological Services**

Counseling and Psychological Services (CAPS) provides a wide range of free *confidential* services to students, faculty, and staff. Services are provided by a staff of professional clinical psychologists, social workers, counselors, learning specialists, and psychiatric providers. CAPS individual and group counseling, workshops, and outreach programs are designed to enhance students' personal experience and academic performance.

Visit us at **[caps.gmu.edu](http://caps.gmu.edu)** for additional resources.

- For consultation or emergency assistance during office hours call 703-993-2380.
- For assistance during non-office hours, call University Police at 703-993-4357.
- 703-527-4077 (CrisisLink)
- 1-800-273-8255 (National Suicide Prevention Lifeline)
- 1-877-838-2838 (Veterans' Crisis Hotline)

**Student Health Services (SHS)** — Provides *confidential* health care to enrolled students in emergency and non-emergency circumstances on the Fairfax, Arlington and Prince William campuses. If there is a medical emergency and Student Health Services (SHS) is closed, please contact the free after-hours nurse ((703) 993-2831), a hospital emergency room, an urgent care facility, or call 911.

**SUB 1, Suite 2300**

**703-993-2831**

### **University Police:**

Emergency: 911

Non-Emergency: (703) 993-2810

Reporting a Crime (Crime Solvers Anonymous Tip Hot-Line): (703) 993-4111

Mason Police Website: <http://police.gmu.edu/>

Eric Heath, Chief of Police

Phone: (703) 993-3840

E-mail: [eheath2@gmu.edu](mailto:eheath2@gmu.edu)