Course Syllabus

BME 460- Biomedical Digital Signal Processing Laboratory

College of Engineering/ Biomedical Engineering

Spring 2022

Instructor: Yu Gan, PhD

Canvas Course Address: see canvas course page for all details and announcements

Course Schedule: Tuesday 6:30pm- 9:20pm @ EAS 231 (Lab location: McLean B03)

Contact Info: ygan5@stevens.edu

Virtual Office Hours: 6:00 PM to 7:00 PM every Friday or by appointment

Virtual session URL: **https://stevens.zoom.us/j/92119998172 (https://stevens.zoom.us/j/92119998172)**

Prerequisite(s): E-232 and E-245

Corequisite(s): NA

Cross-listed with: NA

Teaching Assistant: Hongshan

Contact Info: hliu94@stevens.edu

COURSE DESCRIPTION

This course introduces basic engineering principles of Digital Signal Processing and its application to biomedical engineering. It starts with Euler's theorem, examines Sampling Theory, discusses digital filter design and frequency transformations. There is a lab presence with this class where students analyze the cardio vascular system and delve into aspects of the ECG signal. The ECG foot print is analyzed and detected from Einthoven's Triangle. Actual ECG signals are recorded and then processed with first and second differences to derive heart rate. The students design their own digital filters with Matlab in order to remove signal noise and baseline wander. Spectral signal in biomedical imaging will also be discussed and used for reconstruction and further processing. The effects of different sample rates are also analyzed as the students interpolate and decimate their own recorded ECGs signals with Matlab's resample function. Python will also be provided as a tool to address biomedical signal processing problem.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to…

- Run computer software such as ADI's, lab chart to acquire and analyze data associated with Biosystems.
- Understand digital filtering can be used in place of analog filtering.
- Use Matlab to design filters.
- Perform basic image reconstruction from spectral measurement.
- Process 2D bio-signals.

COURSE FORMAT AND STRUCTURE

This course is on-campus. To access the course, please visit **stevens.edu/canvas (http://stevens.edu/canvas)**. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

TENTATIVE COURSE SCHEDULE

Week	Topic	Assignment
Week 1- 1/24	Introduction + spectrum representation, Expectation	
Week 2- 1/31	Sampling rate	HW #1 assigned
Week 3- 2/7	Lab 1: ECG Peripheral Lab	Lab #1 assigned (HW #1 due)
Week 4- 2/14	Filter design I	HW #2 assigned (Lab #1 due)
Week 5- 2/21	Lab 2: ECG Pulse Bit Einthoven	Lab #2 assigned (HW #2 due)
Week 6- 2/28	No class	(Lab #2 due)
Week 7- 3/7	Filter design II + Review	
Week 8- 3/14	No classes.	
Week 9- 3/21	Midterm exam	
Week 10- 3/28	Lab 3: Measuring Heart Rate using ECG	Lab #3 assigned
Week 11- 4/4	Fourier transform (I)	Lab #3 due
Week 12- 4/11	Fourier transform (II)+ 2D signal processing+AI basics	HW #3 assigned
Week 13- 4/18	Lab 4: Fourier transform in biomedical signal processing	Lab #4 assigned (HW #3 due)
Week 14- 4/25	Lab 5: 2D biomedical signal processing Course review	Lab # 4 due
Week 15- 5/2	Exam	Lab #5 assigned (due in 05/07)

COURSE MATERIALS

Recommended Textbooks:

Student's choice:

Biomedical Engineering Principles, Ritter, Hazelwood, Valdevit, Ascione 13:978-1439812327, 2011, James H. McClellan, DSP First Second Edition 13:978-0136019251, 2015

COURSE REQUIREMENTS

Assignments 45% (Homework 20% + Lab reports 25%):

Expectations for assignments and lab reports are to clearly and neatly present your work. All assignments are due online by 6:30 pm on Tuesday. **They should be in pdf format**. Late assignments will result in 10% reductions per day late. Please make sure you include the honor code statement and sign the end of each assignment. All assignments should be as detailed as possible. For example, problems being solved should state assumptions and show all calculations. Please see rubrics for details.

Exams 45% (20% middle term + 25% final term)

We will have two exams throughout the semester. These exams will be distributed at the beginning of class on the scheduled day. The content of the exams will include all lecture material, presentations given by your peers and reading material posted in CANVAS.

Attendance + Quiz: 10%

Everyone is expected to attend each class and attendance will be taken promptly at the beginning of class. It is imperative that you come to class on time as two late arrivals will result in an absence. We are covering a great deal of information per week. If you run into any issues and must miss class, please contact me so that I can help you navigate with each week's expectations.

There will be in-class quizzes (~10 minutes each). The quizzes will be unannounced. These quizzes will represent 12 total points, 10 of which will count toward the final grade in the class. Extra points accumulated on quizzes will NOT be added to quiz grades. **The number of quizzes and the number of point**s each is worth is up to the discretion of the instructor.

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Canvas

Required Software

- Matlab
- Python

GRADING PROCEDURES

Grades will be based on:

Class Participation+ Quiz	10%
Homework	20%
Lab report	25%
Midterm exam	20%
Final exam	25%

Letter Grade	**Numerical Grade**

A	94 – 100
A-	90 – 93
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	Below 60

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at **http://web.stevens.edu/honor/ (http://web.stevens.edu/honor/)**

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at **www.stevens.edu/honor (http://www.stevens.edu/honor)** .

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

EXAM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1. Students may use the following materials during exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes Conditions: i.e. size of note sheet	X (no more than one page with letter size)	
Typed Notes Conditions: i.e. size of note sheet	X (no more than one page with letter size)	
Textbooks Conditions: i.e. specific books		X
Readings Conditions: i.e. specific documents		X
Other (specify)	Calculator	Laptop

2. Students may use the following materials during quiz. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes Conditions: i.e. size of note sheet		X
Typed Notes Conditions: i.e. size of note sheet		X
Textbooks Conditions: i.e. specific books		X
Readings Conditions: i.e. specific documents		X
Other (specify)		X

3. Students are/are not allowed to work with or talk to other students during quizzes and/or exams.

4. Specific Parameters:

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students.

These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit **https://www.stevens.edu/office-disability-services (https://www.stevens.edu/office-disability-services)** . If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at **pgehman@stevens.edu (mailto:pgehman@stevens.edu)** or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at **care@stevens.edu (mailto:care@stevens.edu)** . A member of the CARE Team will respond to your concern as soon as possible.