

Course Syllabus

BIOE 415: Biomedical Instrumentation Lab

Last Updated: 20-Aug-2023

Course Contact Information

Course Instructor

Instructor Dr. Rebecca Reck

Office Phone 217.300.8461

Email* rreck@illinois.edu

Office 3130 Everitt Lab / 1240A Everitt Lab

Office Hours Fridays TBD in Everitt Lab 0201, Thursdays TBD on Zoom, or by appointment

**Preferred method of contact is Canvas. Refer to the Course help page on Canvas for more information.*

Teaching Assistants

| TA | Email | Section |
|------------------|--|---------|
| Mehzabin Morshed | morshed3@illinois.edu | AB3 |
| Sree Kodimela | vk28@illinois.edu | AB4 |

Course Aides

| CA | Email | Section |
|----------------|--|---------|
| Rachel Bridges | rlb7@illinois.edu | AB3 |
| Steven Hinich | shinich2@illinois.edu | AB4 |

Additional information about asking questions outside of class and office hours will be updated on the Course Help page on Canvas.

Course Information

Credit: 2 undergraduate hours; 2 graduate hours

Course Meeting Times

Every student should be registered for the introduction lecture and one of the lab sections listed below.

Introduction Lecture (AL1): M 12:00 – 12:50 pm in 1306 Everitt Lab

Lab Sections:

- AB3: Mondays from 4:00 – 6:50 pm in 0201 Everitt Laboratory
- AB4: Wednesdays from 1:00 – 3:50 pm in 0201 Everitt Laboratory

Prerequisites

BIOE 205, ECE 205 or ECE 210 and Credit or concurrent enrollment in BIOE414

Course Websites

- Overview: <https://publish.illinois.edu/bioe415-al1/>
- Detailed course information: <https://canvas.illinois.edu>

Resources

Required Lab Manual: Biomedical Instrumentation Lab Manual eText. Available from the WebStore: <https://go.illinois.edu/bioe415etext>. Registered students automatically get 10-days of free access by visiting eText@Illinois and signing-in.

Reference Textbook: *Medical Instrumentation: Application and Design*, 4th ed. John Webster (editor). (ISBN: 978-0-471-67600-3).

Available in print, e-text, and on reserve in Grainger Engineering Library

Required Software: Keysight BenchVue*, MATLAB*, Simulink*, LabVIEW*, Google Docs, TinkerCAD
*Provided on computers in Everitt Lab 0201.

Required Materials:

- Jumper wire kit (some available in the lab)

Assignment Submission: Canvas, GradeScope

Course Discussion Board: TBD

Additional online resources are linked in on the course website and in Canvas.

Course Content

The goal of this course is to make you familiar with how the biomedical instrumentation including instrumentation amplifier, heart rate monitor, ECG amplifiers, and electrodes in BIOE414 (Biomedical Instrumentation) work by testing, designing, and building them.

Catalog Description

Laboratory to accompany BIOE414. Use of sensors and medical instrumentation for static and dynamic biological inputs. Measurement of biomedical signals.

Course Outcomes

1. Analyze, design, and construct operational amplifier and instrumentation amplifier circuits to amplify biosignals.
2. Analyze, design, and construct analog and digital filters to isolate biosignals from unwanted signals.
3. Acquire and display electrical and biological signals on a computer using the appropriate hardware and software tools.
4. Understand biosensor and electrode design and apply them for signal acquisition.
5. Understand the limitations of instrumentation in terms of accuracy, resolution, precision, and reliability.
6. Understand the origin of cardiac and muscle biosignals and acquire data using ECG and electromyogram electrodes.
7. Describe the requirements and limitations of bioinstrumentation in the clinical environment.
8. Function and interact cooperatively and efficiently as a team member in completing laboratory assignments.
9. Present laboratory data in a written format.

Expectations

Laboratory Best Practices

To be successful in the Biomedical Instrumentation Laboratory, you should:

- Be on time for each laboratory session.
- Complete each pre-lab before the due date and be prepared to complete your laboratory experiment. *No late pre-lab assignments will be accepted.*
- Read and follow all instructions provided in the laboratory handouts, on Canvas, and by your instructor. This includes knowing what data needs to be collected to complete the post-lab.
- Complete all work efficiently during laboratory session. Document all observations during the laboratory experiment and save all data in a format and location that will be accessible after your laboratory section.
- Include units where appropriate.
- Double check all your data. Do your results align with your expectations for the experiment? If not, double check your circuit, instrument settings, and associated software.
- Be a collaborative and supportive member of the course by participating in class activities and online discussions.

Attendance

Course attendance is mandatory. In the case class is missed due to a university approved absence (e.g., death in family, COVID-19 exposure, athletics, religious observance), contact Dr. Reck and your TA immediately. Since each lab builds upon previous lab experiments, make up lab times are only during the week when the entire class is doing a lab exercise, so planning ahead is important. See the Course Policies section below for more details about absences.

Preparation

Being prepared for each laboratory experiment will be key to successfully completing each experiment in the allotted time. Before each laboratory, review the provided introductory materials (reading and videos) to understand the background information for each experiment. There will be a pre-lab assignment that ensure that you understand the background information and ask you to complete theoretical analysis of the circuit used in the experiment and complete designs of circuits that will be built as part of the experiment. Each student should review the introductory materials and submit their own pre-lab assignment by 11:59 pm on the Sunday before each scheduled laboratory experiment. If you have questions while working on the pre-lab you may ask during office hours or post your question in the Q&A online.

Rework

Mistakes are a normal part of the learning process. Revising and resubmitting work is a normal part of the engineering and scientific process. For each post-lab assignment that was submitted on-time, you may revise and resubmit it once within a week of it being returned. Your resubmitted assignment should also include documentation of what you changed and why. See instructions for resubmissions on Canvas.

Laboratory Safety

Safety in the laboratory is the top priority. You are expected to understand and follow safety procedures for working with electronics and flammable liquids. Please follow all safety procedures posted in the lab and guidance from teaching assistants and course aides.

Diversity and Inclusion

I am committed to fostering a climate of inclusion and respect in the classroom and laboratory. I welcome students of all backgrounds into my courses. The diversity of participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your or any other student's contribution is not being valued for any reason, please speak with me directly or submit anonymous feedback.

Assignments and Grading

Safety Quiz

Materials will be provided on Canvas about laboratory safety. Review the materials and then complete the quiz on Canvas. You need to earn at least 70% on the quiz by 11:59 am CT on Monday, August 28. You will have up to 3 times to take the quiz and earn at least a 70% before the due date.

Laboratory experiments

Each experiment will have a pre-lab and post-lab assignment to be submitted on Canvas. The pre-lab is an individual assignment that is due at noon on Monday before each scheduled laboratory experiment. No late pre-lab assignments will be accepted because the solutions will be reviewed during the introduction lecture on Mondays. The post-lab assignment is due at 11:59 pm on the Sunday after each scheduled laboratory experiment. Laboratory experiments and post-lab assignments may be completed in teams of two with only one assignment submission required for each team. While you are completing each laboratory experiment, you should adequately document your results and save the data in a location accessible outside of Everitt 0201 (e.g., USB drive, cloud storage) so that you can complete the post-lab assignment after the conclusion of each laboratory section.

Lab Practical Exam

There will be a lab practical exam after all eight (8) labs have been completed. This exam will assess your understanding of the equipment in the lab, the circuits built in the lab, software used during lab, and the concepts covered in pre-lab and post-lab assignments. More details about the timing and content will be provided closer to the exam date.

Design Your Own Experiment

Each team of up to two (2) students will design, prototype, and test a system to capture a biosignal using skills learned in the laboratory experiments. The system should include both hardware and software techniques used in other systems (ECG and temperature) in the laboratory experiments. Not all the parts required to build the prototype will be available in Everitt Lab 0201, so parts acquisition should be included in the plan for the project. Scheduled open laboratory work times for the project are listed in the course schedule below. This experiment counts as the equivalent of two post-lab assignments. The details and expectations this experiment will be provided during the introduction lecture and on Canvas later in the semester.

Assignment Tokens

Each lab group will start the semester with three (3) assignment tokens. These tokens may be exchanged for a 24-hour extension on any due date for post-lab assignments or design experiment deliverables. To use a token, complete the form linked on Canvas. There will be opportunities throughout the semester to earn additional tokens.

Grade Calculation

Your final course grade will be based on how many assignments you submit that meet the specified criteria. The criteria to pass an assignment will be provided in the Canvas assignment when it is posted. You will earn a base grade of A, B, C, D, or F based on the table below. The base grade can be raised by a plus, lowered by a minus, or lowered by an entire letter as follows:

- Add a plus (+) to the base grade if you earn
 - At least 85% of the points on pre-lab assignments, *and*
 - At least 85% on the lab practical exam
- Add a minus (-) to the base grade if you earn
 - Between 50% and 69% of the points on pre-lab assignments, *or*
 - Between a 50% and 69% on the lab practical exam, *or*
 - An unexcused absence from your lab section
- Lower the base grade one full letter if you earn
 - Less than 50% of the points on pre-lab assignments, *or*
 - Less than 50% on the lab practical exam, *or*
 - Two or more unexcused absences from your lab section

Base

Grade Assignments

| | |
|----------|--|
| A | <ul style="list-style-type: none">• Earn at least 95% on the safety quiz by the due date, <i>and</i>• Earn a pass on all eight post-lab reports, <i>and</i>• Earn a pass on all of the design experiment deliverables. |
| B | <ul style="list-style-type: none">• Earn at least 90% on the safety quiz by the due date, <i>and</i>• Earn a pass on seven post-lab reports, <i>and</i>• Complete all design experiment deliverables and earn a pass on two of them. |
| C | <ul style="list-style-type: none">• Earn at least 80% on the safety quiz by the due date, <i>and</i>• Earn a pass on six post-lab reports, <i>and</i>• Complete all design experiment deliverables and earn a pass on one of them. |
| D | <ul style="list-style-type: none">• Earn at least 70% on the safety quiz by the due date, <i>and</i>• Earn a pass on five post-lab reports, <i>and</i>• Complete all design experiment deliverables |
| F | <ul style="list-style-type: none">• Do not meet the assignment criteria in any of the above rows, <i>or</i>• Commit academic dishonesty as defined below in the Academic Integrity policy. |

Tentative Schedule*

| Week | Date | Lecture | Lab | Assignments Due |
|------|-----------|---|--|---|
| 1 | 21-Aug-23 | Introduction to Lab | No Lab | Intro Survey, Safety Quiz, eText & Equipment Purchase |
| 2 | 28-Aug-23 | Intro to Lab 1 | Lab 1: Introduction to Equipment | Pre-Lab 1 |
| 3 | 4-Sep-23 | No Intro – Labor Day | No Lab – Labor Day | Post-Lab 1 |
| 4 | 11-Sep-23 | Intro to Lab 2 | Lab 2: Intro to MATLAB signal processing | Pre-Lab 2 |
| 5 | 18-Sep-23 | Intro to Lab 3 | Lab 3: Op-amp circuits | Post-Lab 2, Live Script, Pre-Lab 3 |
| 6 | 25-Sep-23 | Intro to Lab 4 | Lab 4: Filters | Post-Lab 3 Pre-Lab 4 |
| 7 | 2-Oct-23 | Intro to Lab 5 | Lab 5: Instrumentation Amplifiers | Post-Lab 4 Pre-Lab 5 |
| 8 | 9-Oct-23 | Intro to Lab 6 | Lab 6: ECG | Post-Lab 5, Pre-Lab 6 |
| 9 | 16-Oct-23 | Intro to DYOE | Make-up lab (if needed) | Post-Lab 6, DYOE Proposal |
| 10 | 23-Oct-23 | Intro to Lab 7 | Lab 7: Temperature Sensors | Pre-Lab 7 |
| 11 | 30-Oct-23 | DYOE Kick-off | Open lab - DYOE work time or make-up lab | Post-Lab 7 |
| 12 | 6-Nov-23 | DYOE Office Hours | Open lab - DYOE work time | |
| 13 | 13-Nov-23 | DYOE Office Hours | Open lab - DYOE work time | |
| | 20-Nov-23 | No Intro – Fall Break | No Lab – Fall Break | |
| 14 | 27-Nov-23 | Details for lab practical exam and Intro to Lab 8 | Lab 8 | Pre-Lab 8 |
| 15 | 4-Dec-23 | Lab Practical Exam in Lecture | Lab Practical Exam in Lab | Post-Lab 8, (Optional) DYOE Drafts |
| 16 | 11-Dec-23 | | | DYOE deliverables are due during finals |

*Schedule subject to change. All changes will be posted in Canvas and announced in the introduction lecture.

Course Policies

Academic Integrity

The University of Illinois Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/> Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Use of Generative AI Technology

Generative AI, such as ChatGPT, Bard, and Microsoft Copilot/Bing Chat, can answer questions and generate text, images, and other media. The appropriate use of generative AI varies from course to course. In BIOE415, there are times when generative AI may be useful in the course. If you choose to use generative AI as permitted below, you **must** document and attribute all AI contributions to your coursework and take full responsibility for the contributions including the accuracy of the information and reliability of sources. When using generative AI, keep a journal documenting prompts, AI responses, and your usage. Your instructor may ask you to provide this documentation.

You may use generative AI in BIOE415 for the following:

- Revising your own text for spelling and grammar
- Creating study aids (e.g., flashcards) for quizzes or exams
- Testing and practicing your knowledge of course topics
- Conducting basic research on the course and assignment topics

You **MAY NOT** use generative AI in BIOE415 for the following:

- Generating data for experiments conducted in the course
- During the lab practical examination
- Writing entire sentences, paragraphs, or papers to complete class assignments
- Solving technical design problems, such as selecting component values, creating breadboard layouts, or calculating theoretical system responses.

If you have a question about the use of Generative AI, please reach out to your instructors. Failure to abide by these guidelines is a violation of academic integrity. We will investigate suspected uses of generative AI that do not follow these guidelines and apply sanctions as outlined in the Illinois Student Code.

Attendance

Course attendance is mandatory. However, circumstances may occasionally occur where you need to miss a class some are planned and others are emergencies. Since each lab builds upon previous lab experiments, make up lab times are only during the week when the entire class is doing a lab exercise, so planning ahead is important.

Planned Absences: If you need to miss a class for religious observance, UIUC athletics, interviews, or other reasons you must contact Dr. Reck and your TA at least one week before the absence occurs, to schedule a time to make up the lab, otherwise, the absence will be unexcused, and you will receive a zero for attendance (see grade calculation above). Lab make up times are limited, there is no guarantee that you will be able to reschedule a lab, however, we will do our best to find a time that will work for you and one of the course staff. Any assignments must still be submitted on or before the due date. Additional details for religious observances are included below.

Serious Illness or Family Emergency: If you are seriously ill or experiencing a family emergency that will impact only one lab session, contact Dr. Reck and your TA via e-mail as soon as possible. If you need an extension on an assignment longer than 24 hours, arrangements must be made with Dr. Reck **before** the assignment due date. If your illness or emergency lasts longer than three days (or two lab sessions), you should request an absence letter from the Office of the Dean of Students: <https://odos.illinois.edu/community-of-care/resources/students/absence-letters>. Letters should be requested within 10 days of returning. If you test positive for COVID-19 at an on-campus testing facility it will be automatically recorded.

Religious Observances

Religious observances are an example of a planned absence. Students should complete the [Request for Accommodation for Religious Observances form](#). In order to best facilitate planning and communication, please requests for absence letters as early as possible in the semester in which the request applies.

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the as soon as possible. To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services.

To contact DRES you may visit 1207 S. Oak St., Champaign, call 217-333-4603 (V/TDD), or e-mail disability@illinois.edu, <http://www.disability.illinois.edu/>

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or <http://odos.illinois.edu/community-of-care/referral/>). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at McKinley Health Center (<https://mckinley.illinois.edu/>). Or the Counseling Center (<https://counselingcenter.illinois.edu/>). For urgent matters during business hours, no appointment is needed to contact the Counseling Center. For mental health emergencies, you can call 911.

Anti-Racism and Inclusivity Statement

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to Campus Belonging Resources (<https://diversity.illinois.edu/diversity-campus-culture/belonging-resources/>). Based on your report, Members of the Office of the Vice Chancellor for Diversity, Equity & Inclusion staff will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; conflictresolution@illinois.edu; 217-333-3680) for disciplinary action.

Sexual Misconduct Reporting Obligations

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential

Other information about resources and reporting is available here: wecare.illinois.edu

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

Emergency Response Recommendations

Emergency response recommendations can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/resources-for-instructors/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. <http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>