Sample Syllabus

ME 348 – Circuit Analysis, Instrumentation and Statistics

Syllabus for Spring Semester 2021

(*Subject to change, if necessary)

Lectures: Online via Zoom, MWF 11:15 AM EST – 12:05 PM EST
Labs: Online via Zoom, once per week, 3 hours (times vary according to section number)
Text: No required text – all necessary notes/modules and lab manuals are provided on Canvas
Equipment: Arduino Student Kit (purchased online)
Prerequisites: MATH 251 and PHYS 212
Instructor: Dr. Brian Foley, Assistant Professor of Mechanical Engineering
Office: N-238 Millennium Sciences Complex (MSC)
Office Hours: Dr. Foley → Wednesdays from 2 – 4 PM via Zoom
See Canvas for a list of teaching assistants and/or Zoom links for Office Hours
Contact Info: All communications should be made through Canvas (to help avoid messages being missed in Inboxes)

Course Description

This course is required for all mechanical engineering students, and is taken in the junior year. It serves as an introduction to the fundamental principles of circuit analysis, instrumentation and measurement, as well as statistics. The course includes a 3-hour-per-week, hands-on laboratory where students explore the concepts taught in the lecture. For many students this is the first time they have actual hands-on experience with electronics, circuits and measurement concepts. Given the remote nature of the course due to Covid-19, circuit concepts, data acquisition and sensor applications will be taught through the use of the Arduino Student Kit. Statistical analysis is integrated into the course to analyze and interpret acquired data.

Course Content

- The course is divided roughly in thirds – 1/3 circuits, 1/3 signals, and 1/3 statistics.

Communication and Course Site

- There is a course site on Canvas which will serve as our central online hub for our class. Course materials such as lecture notes, learning modules, links to recorded videos, assignments & solutions (both homework and labs) and various other supporting content will be posted to this site. Canvas will also be where you will submit/complete your homeworks, pre-lab exercises and full lab reports, and answers to exams. Additionally, all grades will be posted via the gradebook on Canvas.
- It is critical that you become familiar with the course Canvas page, checking it often and becoming comfortable with navigating through the site.
- In addition, you are encouraged to seek clarifications and ask questions through the 'Inbox' on Canvas. Responses will be made in a more timely manner if using Canvas and you are encouraged to communicate with the TAs for maximally prompt attention.

Course Material

- Course materials consist of learning modules and lab manuals, available on the Canvas site for this course. These documents are posted under Files.
- The learning modules relevant to topics being covered in lecture should be read ***before*** class to familiarize yourself with the content.
- The lab manuals should be read prior to the start of the lab week.

- Please note that the pre-calculation portion of the lab manual has to be completed **individually** and submitted via Canvas by 11:59 PM EST on the preceding.
- See the 'Lab rules, regulations, and format.pdf' document in the Lab-related folder on Canvas for more information.

Class Participation and Attendance

- **You are expected to attend all scheduled lectures and labs via the associated Zoom links.**
- In case of a university-approved absence, make-up of a course work may be approved. Both the TA and the instructor would need to be alerted to the absence no less than a week before the due date of said-assignment. Refer to the university policy on what constitutes a university-approved absence: https://handbook.psu.edu/content/class-attendance

Grading

You will be assessed and evaluated on the following course assignments:

Reading Assignments	-	Most course topics have a corresponding learning module. The learning module introduces the topic in details and usually includes practice problems with solutions. The learning modules should be read *before* class in preparation. Lecture notes will be posted to Canvas after lecture and should be reviewed to help digest the content.
Labs	30%	For each lab, there is a pre-lab assignment due via Canvas by 11:59 PM EST on the Monday of that Lab week. You will complete the lab during the course of the week and submit a report as part of a ***team***. Completed Lab reports are due via Canvas by 11:59 PM EST on the Friday of that Lab week. **You must attend the weekly lab section assigned to you, logging in to the remote-synchronous session via your lab section Zoom link.** The TAs will be tracking attendance and are there to assist you; think of it as a dedicated 3-hour help session. **Contact Head TA (Matthew D. Erdman) at least a week in advance with any unforeseen scheduling issues and the head TA and instructor will assess accordingly. The class absence form for approval can be found here: http://undergrad.psu.edu/aappm/classabs.pdf** **If a lab is missed without an acceptable excuse, points will be deducted accordingly.** **Read the document 'Lab rules, regulations, and format' on Canvas for additional information.**
Homework (Reg) Super Homework	30% 8%	The due date for each homework assignment is indicated on the course Canvas site/calendar. Homework assignments are due for submission to Canvas by 11:59 PM EST on Fridays.

		Super Homeworks (2 assignments, 4% each) are slightly longer and/or more in-depth than regular homeworks and are assigned during 'No-Lab' weeks (excluding the week of the midterm exam). **NO LATE HOMEWORK WILL BE ACCEPTED.** If a homework is turned in late or if it is missing, a grade of zero will be assigned. If a homework is missed due to an acceptable excuse, the TAs will address the situation accordingly. All homework assignments are comprehensive. All homeworks should be completed and submitted as a group with your same lab team. There should be one main/primary document submission for grading. Please make sure that each student's ***name*** and ***team ID*** is indicated clearly on the cover page of the homework assignment. All students in a group will receive the same grade for that assignment.
Peer-Review	2%	At the end of the semester, group members will have the opportunity to 'Peer-Review' one another, providing an assessment of their team members that will translate to a fraction of 2% points towards the final grade. It is important, both here and in your eventual careers, to be a reliable and collaborative teammate. Remember to communicate and support one another, listening to everyone's input and making sure that everyone contributes to the group efforts.
Midterm Exam Final Exam	15% 15%	There will be two exams: a midterm exam (15%) that takes place over two lecture periods/days and one final exam (15%) during finals week. EXAM SCHEDULE: **Midterm Exam: Online via Canvas & Zoom** **Day #1: Monday March 8th, 11:15 AM EST – 12:05 PM EST** **Day #2: Wednesday March 10th, 11:15 AM EST – 12:05 PM EST** **Final Exam: Online via Canvas & Zoom** **Date and time to be determined by ME/College of Engineering** ***Exams will be timed, are open book/notes and you are allowed to use a calculator.*** If you cannot attend the exam due to a legitimate reason, you must submit a *signed* class absence form to the instructor at least a week in advance for approval: http://undergrad.psu.edu/aappm/classabs.pdf

Grade Disputes

- If you feel there is an error in the grading of an exam, lab, or problem set, it should be first brought to the attention of the grading team the same week the graded material is handed back
- Scores will not be re-considered beyond a week after they are handed back.
- For an official regrade request, you must attach a detailed explanation of the regrade request in writing.

Grading Scale

The grading scale for the course grades at the end of semester if the class course grade average is 70 or higher is:

Final Average	**<60**	**60-69.9**	**70-73.9**	**74-77.9**	**78-81.9**	**82-85.9**	**86-89.9**	**90-92.9**	**93-100**
Letter Grade	**F**	**D**	**C**	**C+**	**B-**	**B**	**B+**	**A-**	**A**

STATEMENT ON ACADEMIC INTEGRITY

- Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle.
- Academic honesty and integrity is of utmost importance. Detailed information on this topic can be found at http://undergrad.psu.edu/aappm/G-9-academic-integrity.html

Some examples are given below:

- COPYING ON TEST: Looking at another unsuspecting student's exam and copying; copying in a complicit manner with another student; exchanging color-coded exams for the purpose of copying; passing answers via notes; discussing answers in exam, etc.
- PLAGIARISM: The fabrication of information and citations; submitting others work from professional journals, books, articles and papers; submission of other students papers or lab results or project reports and representing the work as one's own; fabricating in part or total, submissions and citing them falsely, etc.
- ACTS OF AIDING OR ABEADING: Facilitating acts by others; unauthorized collaboration of work; permitting another to copy from exam; writing a paper for another; inappropriately collaborating on home assignment or exam without permission or when prohibited, etc.
- UNAUTHORIZED POSSESSION: Of examinations, through purchase or supply; stealing exams; failing to return exams on file; selling exams; photocopying exams; buying exams; any possession of an exam without the custodian's permission, etc.
- SUBMITTING PREVIOUS WORK: Submitting a paper, case study, lab report or any assignment that had been submitted for credit in a prior class without the knowledge and permission of the instructor.
- TAMPERING WITH WORK: Changing own or another student's work product such as lab results, papers, or test answers; tampering with work either as a prank or in order to sabotage another work, etc.
- GHOSTING: Taking a quiz, an exam, performing a laboratory exercise or similar evaluation in place of another; having another take a quiz, an exam, or perform an exercise or similar evaluation in place of the student, etc.

- ALTERING EXAMS: When instructor returns graded exams for in class review and subsequently collects them, student changes incorrect answers and seeks favorable grade adjustment asserting that instructor made mistake in grading; other forms may include changing the letter or and/numerical grade on test; obtaining test in discretely, etc.
- COMPUTER THEFT PROGRAM: Electronic theft of computer programs, data, or text belonging to another etc.

Specifically for this course:

- **First offense**: Zero score for the item in question, and infraction reported to the College.
- **Second offense**: Failure of the course, and infraction reported to the College.

STUDENTS WITH DISABLILITIES

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides contact information for every Penn State campus: http://equity.psu.edu/student-disability-resources/disability-coordinator. For further information, please visit the Student Disability Resources Web site: http://equity.psu.edu/student-disability-resources.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/student-disability-resources/applying-for-services. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

COUNSELING & PSYCHOLOGICAL SERVICES (CAPS)

CAPS can help students resolve personal concerns that may interfere with their academic progress, social development, and satisfaction at Penn State. Some of the more common concerns include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs.

You can contact CAPS by calling the Main CAPS number/Appointment Scheduling: 814-863-0395 (Please call between the hours of 8am and 5pm, Monday-Friday to schedule an appointment) or visit us at our office location, 5th Floor Student Health Center.

Online Resources for Relaxation

It's important to take care of yourself. There are a number of valuable online resources that you can use for relaxation and stress reduction. Learn how stress impacts your health and life, as well as some self-help strategies for managing it through the PSU Student Affairs EDGE online workshop. Check out other stress management resources available, including a guided program called Stress Recess. There are also a number of relaxation, visualization, and mindfulness resources at the Mind Body Spa. You can also download mindfulness meditations here. If winter has got you down and you need an upbeat song to listen to, check this out.

Sexual Assault and Relationship Violence Hotline

A hotline has been established for victims and observers of sexual assault and relationship violence. Trained counselors on the hotline will help students access appropriate resources. Penn State students from any campus can call 1 (800) 560-1637 to access the 24 hour a day, seven day a week hotline.

Program Outcomes, Course Objectives, and Course Outcomes

Program Outcomes Mapped to this Course

1e. Statistics
2a. Analysis of mechanical components
2b. Analysis of thermal/fluids components
3a. Work effectively on multidisciplinary teams
3d. Communicate effectively with the written word
3f. Demonstrate professionalism in interactions with colleagues, faculty, and staff
4b. Learning in less structured circumstances
5a. Principles of measurements, instrumentation methods, and experimental design
5b. Exhibit a broad understanding of mechanical instruments and sensors, both in theory and practice
5c. Use appropriate statistical tools
5e. Make effective use of spreadsheets as an analysis and design tool
5g. Computer technology for report writing, presentations, and electronic communications

Course Objectives (Mapping to Program Outcomes is shown in brackets)

A. Understand basic statistics, and develop proficiency in the application of statistical tools. [1e, 5c, 5e]
B. Understand digital data acquisition and spectral analysis of data. [5a. 5b. 5c]
C. Understand basic electronics and circuit analysis for filters, amplifiers, and other signal conditioning circuits, and be able to build such circuits. [5a, 5b]
D. Understand how to design, conduct, and analyze laboratory experiments, and how to properly report the results. [3a, 3d, 4b, 5g]
E. Understand how various kinds of analog and digital sensors and instruments work, how they are calibrated – both statically and dynamically, and how they are applied in engineering. [2a, 2b, 5a, 5b]
F. Advance proficiency in professional communications and interactions. [3f]

Course Outcomes (Mapping to Course Objectives is shown in brackets)

Upon completion of this course, students should be able to:

1. Apply statistical analysis to data samples to calculate mean, standard deviation, etc. and to determine the accuracy, precision, and sensitivity of sensors and instruments. [A, E]
2. Apply statistical and error analyses to measured data to identify and remove outliers and predict uncertainties. [A]
3. Apply linear and nonlinear regression analysis to perform curve fits to data and to determine correlation of variables and trends. [A]
4. Create histograms and probability density functions (PDFs) of data samples, demonstrate the ability to compare the results to standard PDFs such as the Gaussian and student's t PDFs, and demonstrate the ability to predict probabilities based on the PDFs. [A]
5. Apply hypothesis testing techniques to both single variable and paired data samples to predict probabilities and confidence levels. [A]
6. Predict resolution, clipping, and aliasing when using digital data acquisition, and be able to generate frequency spectra using FFTs with and without windowing to determine the frequency content of a signal. [B]
7. Choose appropriate test matrices (design arrays), perform dimensional analysis, and design experiments that minimize cost and time. [D]
8. Build and analyze basic electronic circuits such as amplifiers, filters, Wheatstone bridges, etc., using resistors, capacitors, inductors, diodes, and op-amps. [C, E]
9. Apply differential equation analysis of first- and second-order dynamic systems to predict the behavior of sensors and instruments. [E]

10. Predict, analyze, and test the performance of sensors of various kinds, including strain gages, thermocouples, tachometers, displacement transducers, dynamometers, pressure gages and transducers, laser and Doppler velocimeters, pressure probes, and flowmeters. [E]
11. Demonstrate professionalism in oral and written communications with course instructors and fellow students. [F]