Syllabus for ASEN 3300:
Aerospace Electronics and Communications

Fall 2021
Revised: 08/20/2021

Weekly schedule
Lecture: Pre-recorded; watch before regular lecture period
Recitation: AERO 120, Monday and Wednesday, **8:30 - 9:20 am**
Lab: AERO 141, Tuesday and Thursday, **8:30 – 10:20 am** or **10:40 am – 12:30 pm**

Instructors
Professor Robert Marshall
Office: AERO 419
Phone: 303-492-4075
e-mail: robert.marshall@colorado.edu
Office hours: ~~Fridays 10-11 am~~

Professor Scott Palo
Office: AERO 413
Phone: 303-492-4289
e-mail: scott.palo@colorado.edu
Office hours: TBD

Teaching Assistants
TAs and their office hours will be posted on Canvas as soon as possible.

Lab Coordinator
Trudy Schwartz
Office: AERO 150B
Phone: 303-735-2986
e-mail: trudy.schwartz@colorado.edu

Class Web Portal
- Canvas site at: **https://canvas.colorado.edu**
- Slack workspace: join here: **https://bit.ly/3ylfYJU**

Required Texts and Equipment
- Laboratory Notebook
- ASEN 3300 Lab Kit: Provided to each group and stored in PILOT; to be returned at the end of the semester. Students are responsible for replacement of items broken or not returned.
- **Textbook**: Scherz and Monk, *Practical Electronics for Inventors*, 4th edition; ISBN-10: 1259587541. Available online here: https://www.accessengineeringlibrary.com/content/book/9781259587542?implicit-login=true

Suggested Reference Texts
- Horowitz and Hill, *The Art of Electronics*, 3rd edition; ISBN-10: 0521809266
- Wolfson, *Essential University Physics, Volume 2*, 3rd edition; ISBN-10: 0321976428
- Makarov, Ludwig and Bitar, *Practical Electrical Engineering*, Springer, 2016; ISBN 978-3-319-21173-2 (available as an eBook)

Course Overview

Modern aerospace vehicles rely on electronics, computers, and communications as essential system components. While these systems are most often designed by Electrical Engineers, to be effective as system designers, integrators, and analysts, Aerospace Engineers must have a solid understanding of these critical subsystem areas. The aim of this course is to provide an overview of analog electronics, digital electronics, and communication system concepts as they are used in the aerospace industry. **The emphasis is on practical, hands-on experience and important concepts in a select number of key areas**. Throughout the course, students work in teams to design, build, test, and analyze electronic circuits, work with electronic instruments, interface these instruments to a computer, and implement a communications link. It is our goal that students walk away from this class with a basic understanding of instrumentation electronics, computer interfacing, and radio communications. This understanding is derived from experience building and working with real electronics in the lab.

Course Outline

The course is divided into three main sections: i) analog electronics, ii) digital electronics, and iii) communications. A number of the lab experiments in all three sections are designed to utilize the Analog Devices ADXL321 or 326 accelerometer.

1. In the Analog Electronics section of the course we look at the accelerometer output to study vibrations of a beam. In the process, we build passive circuits to lower the output range of the accelerometer and active circuits to amplify it, conditioning circuits to filter noise in the output, and learn to use multimeters, oscilloscopes, and spectrum analyzers.
2. In the second section of the course on Digital Electronics, we log data from the accelerometer instrument to the lab station computers and discuss relevant issues such as communications protocols, analog-to-digital and digital-to-analog conversions, and sampling.
3. In the final section of the course on Communications, we will use the accelerometer data as a source of telemetry; modulate carrier signals, compute satellite communications link budgets, and design and conduct a GPS receiver experiment.

Prerequisites

Physics II, Aerospace Mathematics, and Introduction to Dynamics and Systems are prerequisites for this course. In fact, much of the material covered in this class you have been exposed to already in these earlier courses. We expect you to build upon this experience base and make connections between the new material and the old. In ASEN 2001-2004 you have seen and used instrumentation electronics, but in general, someone else took care of designing them. In Physics II you covered some circuit theory, but did not build any practical systems. For this course it is assumed that you have a working knowledge of the prerequisite material. We will build on this foundation by revisiting these topics in more detail and conducting hands-on laboratory experiments.

Class Format

The semester is organized into 12 weekly laboratory modules, with other weeks reserved for exams. With the exception of the first lab, each lab module lasts one week beginning with the Monday lecture session. The Monday lecture introduces the concepts and materials to be studied in the lab, and provides an overview of the reading materials and the lab activities, including a pre-lab homework assignment. The following Tuesday lab session begins group lab work on the week's assignment. Instructors and teaching assistants are available in the lab to answer questions, demonstrate how to use equipment, and discuss the material with individual lab groups. The second lecture period is used to finish the topic of the ongoing lab and answer questions about the experiments; the weekly quiz will then be held at the end of the Wednesday lecture period. Thursday's lab section continues the group work in

the lab with emphasis on documentation of methods and analysis of results for inclusion in the lab report. **Group lab reports are due the next day, Friday, at 5 pm,** and will be submitted **online via Gradescope** (as a PDF) for grading. Please review the Lab Guidelines handout for more information. We will try to grade the group lab reports within one week.

Assessment / Written and Practical Exams

Assessment of individual student knowledge and ability is conducted **using written and practical examinations**. For the schedule of the exams please see the class schedule. Written exams will take place remotely & synchronously (i.e. at home) and the practical exam will take place either at home or in the lab, according to student preference. The practical exam involves demonstrating knowledge and skills such as proper use of equipment, how to set up a circuit, and how to perform measurements.

Course Grading

The final grade is a combination of individual and group work.

Type	**Description**	**Percentage**
Individual Work (IW) (65% total)	Quizzes (best 11 out of 12)	10%
	Exam #1 (midterm)	10%
	Exam #2 (midterm)	10%
	Practical Exam	10%
	Final Exam	20%
	Faculty, TA, and Peer Evaluation	5%
Group Work (GW)	Lab Reports (12)	25%
	Pre-lab assignments	10%
Final Grade (FG)	If IW > 70% FG = 0.65*IW + 0.35*GW else FG = IW	

Take note of the last line above: If your individual work grade is less than 70%, then the group work will not be included in your final grade, and your final grade will be given by your individual work only. Otherwise, individual work accounts for 65% of your final grade, and group work accounts for the other 35% of your final grade.

Exam grade replacement:

To reduce stress from the early exams, we will provide the following incentive:

- If your grade on the final exam is better than your grade on one or both of the midterm exams, then ONE midterm exam grade (the lowest) will be replaced by the average of your grades on that midterm and on the final exam.
- For example: a student scores 75% on the first exam, 85% on the second exam, and 90% on the final exam. As the lowest grade, the first exam grade will be replaced with (0.75 + 0.9)/2 = 0.825 or 82.5%. The other two exam grades will not change.

Rationale for course assignments:

- Homework reinforces the mental processes that help you to become proficient in a subject. The prelab quizzes largely serve as your homework assignments in this class. We also encourage you to work additional problems for practice. Before beginning any assignment, you should read the text and work the examples in the text.

- Experimental laboratory exercises are either more complex than hands-on homework or require special equipment. You will work in pairs to collect and analyze the data, as well as write up the experimental laboratory report.
- Exams and quizzes provide a gauge to determine what you have learned individually.
- Lab experiments help you to learn how to synthesize the basic concepts, methods, and tools presented in the course curriculum. The team-oriented lab approach will give you experience in working and cooperating in groups as is typical in industry.

Assignment Submission and Late Policy

1. Prelabs:
    a. Submitted as a Canvas "quiz", and due at 8:30 am Tuesday, before the first lab period starts, nomatter which lab section you are in.
    b. Prelabs will receive a 10% deduction for each day late. A prelab submitted at 8:31 am is considered late, so don't wait until the last minute to submit.
    c. Prelabs will not be accepted after 5 pm Monday, when labs are due (6 days late).
2. Quizzes
    a. Quizzes are conducted on Canvas at the end of the Wednesday lecture period, starting at 9:05 am. You will have 15 minutes to complete the quiz.
    b. If you can't make it to lecture, you should still plan to do the quiz at 9:05 am from wherever you happen to be.
    c. Your quiz grade will take the best 11 out of 12 quizzes; this policy is designed to accommodate missed quizzes.
    d. No makeup quizzes will be provided as quiz solutions are provided shortly after the quiz.
3. Lab reports:
    a. Due at 5 pm each Friday; however, there is a grace period for submission until 5 pm on Monday. Labs submitted after 5 pm Monday are considered late and the following policy applies:
    b. 10% deduction for each day late. An assignment submitted at 5:01pm is considered late, so don't wait to submit.
    c. Labs will not be accepted after 5 pm Friday (4 days past the Monday deadline).

Exam and Assignment Regrading

Regrading requests for any assignment must be submitted within 1 week after the assignment has been returned. All regrading requests must be coherent and show a clear understanding of the problem. Generic requests for more points will not be considered.

Communications

- All questions regarding course content (lecture material, prelabs, quizzes, exams, lab assignments) should be posted to the course **Slack workspace** or asked during lab, lecture, or office hours.
- Please post questions about lab, prelab, and quizzes in the relevant channel for that lab. Use the #general channel for course logistics questions.
- We encourage you to use the #random channel for fun (but appropriate) posts that are peripherally related to the course.
- If we receive an email with a prelab or lab question, we will direct you to post on the course Slack workspace and relevant channel.
- The teaching team will make every effort to respond to course related Slack posts in a timely manner (typically within 1 business day).
- Questions posted 24 hours or less before an assignment deadline may not receive a response before the deadline.

- Any question, concern, or issue not regarding course content or of a personal nature should be e-mailed to a course instructor.
- Any emails sent to a member of the teaching team should include ASEN3300: in the subject line.
- We cannot guarantee that emails and Slack posts will receive a response outside of regular business hours, i.e. Monday through Friday, 8:00 am – 5:00 pm MST/MDT.
- **We strongly encourage you, the students, to answer each other's questions in Slack.** This is a great way to work together to solve problems, and not have to wait for an instructor or TA response.
- We reserve the right to make changes to the weekly course schedule based on unexpected events that may come up during the semester. We will give sufficient advance notice through announcements in class and posting on Slack. Changes to this syllabus may be announced at any time during class periods, and an updated syllabus document will be posted on Canvas.

Cheating

Cheating will not be tolerated and the CU Honor Code will be upheld.

As group work is part of this class (lab experiments and report), it is useful to clarify what is considered cheating. You are expected to perform the lab assignments as a group and divide the workload equally. Communication within the group is encouraged. It is OK to discuss the assignments and reports with fellow students in the class as long as this is done with the intention of learning, i.e., understanding the material. Sharing results or data analyses is permitted only under specific circumstances, when there is no way for you to retake the data or redo the analysis. For example, if you realize after finishing your lab work that your data are erroneous, you may use and analyze the data from a different group. However, in this case, you need to provide a full disclosure and explanation why data sharing was necessary, and give proper credit to the source. You may also want to notify the instructor(s) and/or the TAs.

Getting help with the lab work and reports from outside the class is generally not permitted. This includes help from senior students or using lab reports from previous years.

When in doubt about what is considered unethical, you should always exercise caution and ask the instructor(s) if they have any questions or concerns that what they are doing may be a violation of the honor code.

Weekly Schedule

Topic	Day	Time	Type	Submission
Pre-recorded lectures	Posted Thursday	by 5 pm		
Prelab Due	Tuesday	8:30 am	Individual	Canvas
Weekly Quiz	Wednesday	9:05-9:15 am	Individual	Canvas, In Lecture
Lab Due	Friday	5 pm* (see above)	Group	Gradescope

Some Logistics

1. Students are assigned to a team of 3 persons for the duration of the semester.
2. Teams work together to study the lab; design, implement, test, and analyze their circuits; and write the lab reports. Students are encouraged to collaborate in preparing for quizzes, discussing lab questions and results.
3. Each individual student can decide how to organize their own notes, but results should be clearly transcribed into the final lab document.
4. Weekly quizzes and all exams are to be completed individually. Any type of collaboration or copying constitutes cheating and will result in a zero grade for all parties involved and will be reported. A repeated instance of cheating will be reported on the student's permanent record and will result in an F for the course. Please see also Honor Code web pages at http://www.colorado.edu/academics/honorcode/.
5. Weekly quizzes will be conducted in person, at the end of the Wednesday lecture period. Quizzes will be conducted on Canvas; **students must bring an appropriate device (i.e. computer, tablet, etc) in order to complete the quiz online during lecture period.**
6. The purpose of the prelab assignment (completed individually) is to prepare you for the weekly lab. It is important to complete the prelab before the first lab session; otherwise you will have difficulty completing the lab in the allotted lab time. Answers to prelab questions will be entered into Canvas.
7. Lab exercises are conducted together with your team and a single lab report is submitted at the end of the week via Canvas. Collaborations with other groups including shared diagrams or extensive discussion of results must be acknowledged in your report. Copying text or answers from another group with or without their permission constitutes cheating and will result in a zero grade for the weekly lab module. A repeated instance of cheating will be reported on the student's permanent record and will result in an F for the course. Please see the Honor Code web pages at http://www.colorado.edu/academics/honorcode/.
8. University closure: If an assignment is due and the University is closed due to weather or other circumstance, then the assignment will be due on the next day that the University is open. In the event that a lab or lecture is cancelled due to a University closure, please check the website and Canvas announcements for updated information. All critical communications will be conveyed through Canvas announcements.
9. Please check your schedules as soon as possible to determine if you expect to miss class on any of these days for religious or other reasons. If there is a conflict, it is the student's responsibility to notify the instructors as soon as possible to make alternate arrangements. Make up exams due to illness require a note from a physician. Copying, collaborating, or discussing material in a written or oral exam during the exam period constitutes cheating and will result in an F for the course, and will be reported on the student's permanent record.

University Policies - Fall 2021

Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior and the Student Conduct & Conflict Resolution policies.

Requirements for COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus.

As of Aug. 13, 2021, CU Boulder has returned to requiring masks in classrooms and laboratories regardless of vaccination status. This requirement is a temporary precaution during the delta surge to supplement CU Boulder's COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined, please inform the instructor currently leading the class of your absence, and we will develop a plan for any missed assignments or assessments. You are not required to inform the instructor of the nature of your illness, and you are not required to submit a doctor's note.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names

and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering an inclusive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about OIEC, university policies, reporting options, and the campus resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, you must let the instructors know of any such conflicts within the first two weeks of the semester so that we can work with you to make reasonable arrangements. See the campus policy regarding religious observances for full details.