

Syllabus for ASEN 3300: Aerospace Electronics and Communications

Spring 2021, Chu & Morton

Revised: 1/10/2020 by J. Morton

Weekly schedule

Lecture: Pre-recorded; watch before regular lecture period

Recitation: Remote (Zoom); Monday and Wednesday, **8:30 – 9:20 am**

Lab: Remote (Zoom), Tuesday and Thursday, **8:30 – 10:20 am** or **10:40 am – 12:30 pm**

Recitation, Lab, and Instructor Office Hours Zoom Link: <https://cuboulder.zoom.us/j/92187426513>

Instructors

Professor Xinzhao Chu

Office: CIRES 241

Phone: 303-492-3280 (Will not be there)

e-mail: xinzhao.chu@colorado.edu

Office hours: M 4-5PM

Teaching period: 3/1-4/25

(Zoom link above)

Professor Jade Morton

Office: AERO N403

Phone: 303-492-8630 (Will not be there)

e-mail: jade.morton@colorado.edu

Office hours: MW 9:20-10:00AM

Teaching Period: 1/14-2/28 & 4/26-5/3

(Zoom link above)

Teaching Assistants and their Office Hours

Emanuele Costantino, Emanuele.Costantino@colorado.edu

Tu Th, 12:30-1:30PM, <https://cuboulder.zoom.us/j/94091567294>

Daniel Crook, Daniel.M.Crook@colorado.edu

Tu, 2:40-4PM, <https://cuboulder.zoom.us/j/95358902876>

Isaac Timko, Isaac.Timko@colorado.edu

F 1:30-2:30PM, <https://cuboulder.zoom.us/j/92788304585>

Douglas Brough, douglas.brough@colorado.edu

Tu, 4-5PM, <https://cuboulder.zoom.us/j/98104411674>

Nick Miller, nimi1223@colorado.edu

Th, 6-7PM, <https://cuboulder.zoom.us/j/6771813327>

Lab Coordinator

Trudy Schwartz

Office: AERO 150B

Phone: 303-735-2986

e-mail: trudy.schwartz@colorado.edu

Lab Assistants and their Office Hours

Ruben Hinojosa Torres, Ruben.HinojosaTorres@colorado.edu

MWF, 1:50-2:50PM, <https://cuboulder.zoom.us/j/91504850022>

Jarrod Puseman, japu8876@colorado.edu

MF 11:15AM-1:15PM, <https://cuboulder.zoom.us/j/96313556989>

Class Web Portal

Canvas site at: <https://canvas.colorado.edu>

Required Texts and Equipment

- Laboratory Notebook
- ASEN 3300 Lab Kit: Provided to each student; 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 at:

<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. 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. 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. 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 details and conducting hands-on laboratory experiments.

Class Format

The semester is organized into 12 weekly laboratory modules with other weeks utilized 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 with an evaluation of the pre-lab assignment, followed by group lab work for the remainder of the period. Instructors and teaching assistants are available on Zoom 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. A weekly quiz will be given during last 10 minutes of the second lecture. Thursday's lab section continues the group work on the lab with emphasis on documentation of method and analysis of results for inclusion in the lab report. **Group lab reports are due 5PM on Monday** and will be submitted as **online via Gradescope** (as a PDF) for grading. Please review the Lab Guidelines handout for more information. The group lab reports are graded and returned to your group in one week whenever possible.

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 semester schedule. Written exams will take place remotely & synchronously (i.e. at home) and the practical exam will take place at home. 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) (60% total) | Quizzes (best 11 out of 12) | 10% |
| | Written Exam #1 | 10% |
| | Written Exam #2 | 10% |
| | Final Written Exam | 20% |
| | Practical Exam | 10% |
| Group Work (GW) | Lab Reports + Prelab (12) | 40% |
| | Peer Evaluation Factor (PEF) | 0.5 – 1x |
| Final Grade (FG) | $FG = IW + (PEF \times GW)$ | 100% |

Final Course Grade: Your final course grade is computed as follows:

- Your individual grade is calculated as $IW/0.6$ (normalized to the 60% maximum)
- If your individual grade is C or better, then your final grade (FG) is the sum of the Individual Work (IW) and Group Work (GW) grades:

$$FG = IW + (PEF \times GW)$$

- If your individual grade is below a C, then your final grade is the individual grade.
- The Peer Evaluation Factor (PEF) is a percentile value of your effort in the lab and completing the report.

Rationale for course assignments:

- Homework reinforces the mental processes that help you to become proficient in a subject. In addition to the assigned lab reports, we 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.

Grading Philosophy

The individual grade is the measure of the competency and will indicate your level of understanding the

course materials, and is assessed through the quizzes and exams. The group (lab) work is designed to enrich your learning experience and prepare you for success in the real-life work environment. Accordingly, the group grade is incorporated into the final grade only if your individual grade is a C or better. This policy makes it important to use the lab work to enhance your own learning. If the work in the assignment is split up among group members, be sure that the learning is not also split up, but is shared among the whole group. At the end of the semester, you will evaluate your peers and submit your scores to the instructors. The Instructors will take your input and assign a PEF score between 50% and 100% for each student for their effort in the lab and completing the reports. The group work (GW) grade will then be multiplied by the PEF score and added to the individual work (IW) score to calculate your final grade. The PEF score is thus a very significant part of your final grade and it is there to ensure that all students are contributing to the group work.

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.

Logistics

1. Students are assigned to a team of 3 persons for the duration of the semester.
2. Each student is issued a lab kit to take home and keep for the duration of the semester. Lost or broken components must be replaced by the student; faulty components will be replaced by the teaching team.
3. 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.
4. Each individual student can decide how to organize their own notes, but results should be clearly transcribed into the final lab document.
5. 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/>.
6. Weekly quizzes will be conducted on Canvas. The quiz will be released on **Monday at 5 pm**, and **must be completed before the first lab session on Tuesday at 8:30 am**. Students can take the quiz at a time of their convenience within this window; however, once the quiz is started, you will have 10 minutes to complete it. Once you complete the quiz, sharing questions and/or answers with other students who have not yet completed the quiz will be considered cheating.
7. 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, along with answers to the remainder of the lab report.

8. 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/>.
9. Lab reports are due at 5 pm each Monday. If late, the following deductions will be made:
 - a. 10% deduction for the group if turned in before midnight the same day
 - b. 50% deduction if turned in within one week of the due date
 - c. No credit afterwards
10. No make-up quizzes will be given or late labs accepted (past one week) except under extenuating circumstances such as school closure or sudden illness. Your lowest quiz/prelab scores will be dropped in order to allow for unforeseen incidents.
11. 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.
12. 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 – Spring 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 Code of Conduct](#).

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 public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,
- clean local work area,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert [CU Boulder Medical Services](#).

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 policies on [COVID-19 Health and Safety](#) and [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the “Accommodation for Disabilities” statement on this syllabus.

All students who are new to campus must complete the [COVID-19 Student Health and Expectations Course](#). Before coming to campus each day, all students are required to complete the [Buff Pass](#).

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 advise the instructors as soon as possible to discuss plans going forward.

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. Violations of the policy may include: 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 at the [Honor Code Office 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 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 cureport@colorado.edu. Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and 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 options for

reporting and support resources.

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.