

ASEN 5090 INTRODUCTION TO GNSS - SYLLABUS

Lecture MW 11:30-12:45 AM, AERO 114

Instructor: Yang Wang

Teaching Assistant: Madeline Evans

Office hours & locations: TBD

Logistics for Fall 2024

This fall, ASEN5090 will be available in-person and via on-line learning. Students registered in the ASEN5090-001 section are expected to attend the scheduled lectures regularly in person; however, there is no problem making up a few lectures by watching asynchronously online if you are ill or have other personal reasons for missing class. Students registered in the ASEN5090-002 section are expected to watch recorded lectures asynchronously; however, if seats become available in the classroom, students may come in person.

Overview

ASEN 5090 *Introduction to GNSS* is a core Aerospace Engineering Sciences (AES) course for the Astrodynamics and Satellite Navigation Focus Area. It provides an overview of the principles of operation of global satellite navigation systems (GNSS) with primary emphasis on the U.S. Global Positioning System (GPS). This course covers the fundamentals of both hardware and algorithms/software aspects of GNSS and is meant for graduate students interested in pursuing further study in GNSS as well as those pursuing specializations in astrodynamics, vehicle systems, remote sensing, communications, and other fields that rely upon GNSS instruments. ASEN 5090 is a prerequisite for advanced satellite navigation courses including ASEN 6091 GNSS Receivers, ASEN 6090 GNSS Software and Applications, and ASEN 6591 GNSS for Remote Sensing.

Prerequisites & Eligibility

ASEN 5090 is open to graduate students in Engineering, Physics, Applied Math, Geological Sciences, Geography, and related fields. Advanced undergraduates who are interested in taking the course must get instructor permission. Students are expected to have good problem-solving skills, physics, calculus, vector and matrix math, linear algebra, computer programming, and the ability to write clearly.

Required Textbook:

Global Positioning System, Signals Measurements, and Performance, Revised 2nd Edition, by P. Misra and P. Enge, Ganga-Jamuna Press. You can find it on Amazon or at the bookstore.

There are two different versions of the 2nd edition available that you might find online. Both are fine. You should NOT purchase the 1st edition. It is missing a number of sections that we will use.

Recommended Reference Book

Position, Navigation, and Timing Technologies in the 21st Century, Ed by Y.T.J. Morton, et al.

Available for download through the CU Libraries:

Vol 1: <https://ieeexplore-ieee-org.colorado.idm.oclc.org/book/9304973>

Vol 2: <https://ieeexplore-ieee-org.colorado.idm.oclc.org/book/9304974>

Springer Handbook of Global Navigation Satellite Systems, Ed by P.J.G. Teunissen & O. Montenbruck.

Available for download through the CU Libraries: <https://link.springer.com/book/10.1007/978-3-319-42928-1>

Subject Outline

1. GNSS Basics
2. Measurements and Errors
3. Position Solutions
4. GPS Signals and Receivers
5. Applications

Assignments

There are 8 homework assignments that range from working assigned problems in the book to a series of assignments that build up to programming a GPS position solution. Collaboration is permitted and encouraged on these assignments. This means you may discuss the means and methods for solving problems and even compare answers, but you are not free to copy solutions from classmates or from internet resources. The work that you turn in must be your own--copying is not allowed for any assignments. Students who are found to be copying any portion of an assignment will be reported for violation of honor code and may incur both academic and non-academic sanctions.

Each homework assignment will identify what must be turned in and the deadline for submission, which is the same for both on-campus and distance learning students. All assignments are to be submitted via Gradescope, accessible through the course CANVAS page. Up to two late assignments per student will be accepted.

Exams

There will be a midterm exam in week 8/9 and a final exam due on the campus-assigned date/time. Both exams will be administered as take-home exams via Canvas/Gradescope. Each student, whether on-campus or distant, is personally responsible to abide by the CU Honor Code and the exam rules specified on the assignment. Any violation of this requirement including collaboration or copying on an exam constitutes cheating and will result in an F for the course. An honor code violation report will also be filed with the honor code office.

Grading Policy

Grades on individual assignments and for the overall course are set based on the following criteria.

- A, A- Demonstrates superior understanding of the material, excellent technical work
- B+, B Demonstrates comprehensive understanding of the material, strong technical work
- B- Demonstrates adequate understanding of the material, complete technical work
- C Demonstrates barely adequate understanding of the material and minimally sufficient technical work, not satisfactory to fulfill graduate degree requirements
- D Poor technical work
- F Unsatisfactory performance

Final grades will be based on the following weighting

Midterm Exam	15
Final Exam	15
<u>Assignments</u>	<u>70</u>
Total	100

University Policies

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure 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 [classroom behavior policy](#), the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

Requirements for Infectious Diseases

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all public health orders to reduce the risk of spreading infectious diseases. The CU Boulder campus is currently mask optional. However, if masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class. Students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct & Conflict Resolution. Students who require accommodation because a disability prevents them from fulfilling safety measures related to infectious disease will be asked to follow the steps in the "Accommodation for Disabilities" statement on this syllabus. For those who feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the [further guidance of the Public Health Office](#). For those who have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

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 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 Student Conduct & Conflict Resolution (honor@colorado.edu); 303-492-5550). Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to 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

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these policies, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and support resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](#).

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. For this class, you are expected to review the course schedule and let the instructor know within the first two weeks of the semester of any such conflicts so that we can work out an accommodation plan. See the [campus policy regarding religious observances](#) for full details.