ASEN 2003: Introduction to Dynamics and Systems
Syllabus, Spring 2022

Lectures:

- Section 100: Monday and Wednesday 12:50pm-2.05pm in AERO 120
- Section 200: Monday and Wednesday 2:20pm-3.35pm in AERO 120

Labs:

Sec.	Day	Start	End	Room
301	TTH	12:40 PM	2:30 PM	AERO 141
302	TTH	2:45 PM	4:35 PM	AERO 141
303	TTH	12:40 PM	2:30 PM	AERO N100
304	TTH	2:45 PM	4:35 PM	AERO N100

Instructor Information

Name: Prof. Natasha Bosanac (she/her/hers)

My office hours are Fridays 1-3pm MT over Zoom during weeks 1-4, 13-16.

You can reach me at natasha.bosanac@colorado.edu

Name: Prof. Daniel Scheeres

My office hours are TBD over Zoom

You can reach me at scheeres@colorado.edu

Lab Instructor Information

Name: Prof. Bobby Hodgkinson (he/him/his)

Office Location: AERO 150D

You can reach me at hodgkinr@colorado.edu

Teaching Assistants/Fellows Information

Lead TA: Giuliana Miceli giuliana.miceli@colorado.edu
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Course Overview

Instruction mode: In-person (except when the university operations require remote teaching)

Course webpage: canvas.colorado.edu

Course overview:

The study of dynamics is a key component of every undergraduate engineering major and is especially relevant to Aerospace Engineering. In the upper division you will begin taking courses dealing with the dynamics of air and space vehicles, building upon the fundamentals presented in this class. Structures, fluids, controls, and orbital mechanics all have roots in this material, so it is critical that you build this technical base carefully.

In this class the fundamentals of two-dimensional motion of particles and rigid bodies are presented from both a theoretical and practical point of view. In addition to deriving and using first principles of dynamics, we will do experiments, designs, and hands-on work that are intended to help students develop an intuition or feel for dynamics. Furthermore, we take the

study of simple motions one step further by introducing the fundamental concepts of vibrations and control into this course. Vibration analysis is critical to aerospace vehicle design, and as engineers we must both understand the motion of vehicles and learn how to modify the vehicle to suit mission requirements. This course will give you a flavor of these advanced topics, laying the groundwork for more advanced studies in your junior and senior years.

We will cover the following topics:

1. Particle Kinematics and Kinetics
2. Particle Energy and Momentum Methods
3. Planar Rigid Body Kinematics and Kinetics
4. Rigid Body Energy and Momentum Methods
5. Vibrations
6. Systems and Control

Notes:

1. Lecture notes, course videos, and any course materials provided to you may not be distributed publicly or shared with individuals who are not registered in the course this semester without instructor consent.
2. The information contained within this syllabus is subject to change as needed during the ongoing pandemic.

Textbook

Required: *Engineering Mechanics: Dynamics,* by Bedford and Fowler, Fifth Edition, 2008.

ISBN VP ISBN-10: 0132971135

Prerequisites

Physics 1, ASEN2001, and ASEN2012, APPRM2350 are prerequisites for this course. APPM2360 is a pre or co-requisite. Much of the material covered in this class has been introduced in your freshman physics class. It also depends heavily on a solid understanding of statics. Students are expected to have a working knowledge of vector operations and vector calculus. Assignments regularly require the use of MATLAB; students are expected to be proficient in the use of MATLAB for problem solving.

Course Components

Material and concepts are introduced, and proficiency is evaluated using several mechanisms throughout the course:

Reading Assignments: The primary means for conveying factual information, techniques, and examples is reading assignments in the textbook and course notes. The textbook is excellent, providing clear explanations and numerous examples of varying difficulty. Take advantage of this outstanding resource. Reading assignments are expected to be completed prior to the class lecture period.

Lecture & Discussion: We typically start a new topic in each lecture session. The instructor will provide a complementary overview of the material covered in the reading assignment.

Homework: Homework problems are generally assigned once per week. They provide practice in solving problems of varying difficulty and sometimes will also involve computing. Collaboration on homework is allowed (copying from others or solution manuals is not); however, students are encouraged to use homework as a means to ensure their individual proficiency of the subject. In-class group problem solving and labs will allow for considerable collaborative problem solving.

Group Problem Solving: In the lecture and lab periods we will sometimes have group problem solving sessions. A handout is provided with conceptual questions about the material and/or relevant problems (often from previous year's exams). Students work in groups to answer conceptual questions about the material and work practice problems in preparation for the unit exam. We discuss the questions and problem solutions in class.

Labs: There are a variety of experimental and design labs in this course that offer a different perspective on the material. They vary in duration and requirements. Each lab handout will state the objectives of the assignment, the report requirements, and the weighting (number of points) in the overall lab grade. In some cases, students will observe dynamic phenomena in the lab before we formally discuss the theory and do practice problems. Why do it in this order? The idea behind this type of "discovery learning" is that it helps you develop a concrete mental picture to connect to abstract mathematical concepts; and, it allows the student to formulate the questions that need to be answered to fully understand the experiment. In particular, we have tried to avoid making the labs "canned" or "turn-key"; that is, you should **not** expect to be able to walk into the lab, collect some data, and crank out a fill-in-the-blank answer to the lab questions.

The labs are designed so that you **should** expect to have to try out several different approaches or ideas, puzzle over and discuss surprising results, debug and adjust models, and ultimately demonstrate a clear understanding of the material. We encourage you to work with your team to figure things out, ask questions of the instructors and TA's when you are stuck, make some calculations, and maybe redo the experiment based on what you observed. The final result of the lab is not a "right" answer, but rather a set of answers and a solid explanation, based on correct mathematical theory and good experimental practice, of why such results were obtained.

In some laboratory exercises, we will stress data analysis skills. This includes extensive usage of computer programming and statistics taught in ASEN2012. In these examples, we expect students to follow directions from the instructor and provide a lab write-up that demonstrates that students understood the key concepts of the lab. Presentation of results will be stressed and students are expected to properly describe what was measured, what was modeled, and whether discrepancies between observations and models are significant. Although the computer programs written for this class will not be graded, students are required to turn them in. Students will also be required to follow programming instructions made by the instructor. Our purpose in making these programming requirements is to teach students new and efficient methods for conducting engineering analyses. Proper presentation of laboratory results is important throughout the ASEN curriculum.

Exams: Four *evening exams* will be conducted at ~3 week intervals and administered remotely. Exams will include both conceptual questions and more detailed problems similar to homework or lab analysis.

Final Exam: The *final exam* will contain material from the entire course and will be administered remotely. If you have 3 or more finals scheduled for the same day, university policy allows you to request a rescheduling of the exams in excess of 2. Please check your schedule and notify the instructor within the first 2 weeks of the semester if you will require a rescheduled exam for this class.

Homework Policies

Homework posting and submission

- Homework assignments will be posted on Canvas/Gradescope with the due date & time clearly listed.

- Assignments will generally be due at a specific time in the evening on the specified day to accommodate students who need a flexible schedule due to their current location, work, care, or other commitments.
- All assignments are to be submitted in Gradescope (be sure to include team members for group assignments).
- Once you submit your assignment electronically, please double check that the file has uploaded correctly, is readable and is not corrupted; it is your responsibility to ensure it is uploaded correctly and we cannot grade a homework if we cannot open the file.
- Late homework will not be accepted, but the lowest two homework grades will be dropped (see below).
- Solutions will be posted on Canvas after the due date.

Collaboration vs copying/plagiarism

- Collaboration is permitted on homework. You may discuss the means and methods for formulating and solving problems and even compare answers, but you may not copy someone's assignment. Copying material from any resource (including solutions manuals) and submitting it as one's own is considered plagiarism and is an Honor Code violation. Remember, the more you think about the problems yourself, the more you learn, and the more successful you will be on exams and in subsequent courses.
- Directly copying from a solution manual or other source is considered plagiarism.
- While we strongly discourage students from relying on a solutions manual for pedagogical reasons, we will not consider the use of a solutions manual as plagiarism. What is critical is that students solve the homework on their own, regardless of the tutoring or resources they used, and not turn in a copy of someone else's work. Thus, copying another student's homework or the answer key and turning it in is plagiarism and a violation of the honor code.

Content

Homework submissions must demonstrate an understanding of the principles involved by including: diagrams, using correct notation and terminology, explaining the approach in a clear and technically precise manner, showing the key steps and intermediate quantities used to obtain the solution, discussion of relevant theory and technical concepts, and outlining the answer with proper units. These problem-solving steps are critical for developing problem formulation skills. A commented code or script is not considered a homework solution; for credit, a write-up (by hand or typed using word-processing software) with the components described above must accompany the solution to each problem (unless otherwise specified).

Format

- Homework should be neatly handwritten with a new page for each problem. Typed homework is acceptable if you prefer it but is definitely not required or encouraged. If you write a MATLAB script or function to solve the problems, the code must be included at the end of your submission.
- Always submit work with a professional appearance. Neatness, clarity, and completeness count. Very messy work will not be graded, receiving a score of zero.
- Vector notation must be used when appropriate. Numerical values must include units and a meaningful number of significant digits. Final answers must be indicated with an arrow, underline, or box.

Grading

- For grading purposes, homework is considered part of the group grade and only contributes to the total grade when the individual work is C or better.
- Homework is graded partially based on completion of all assigned problems (approx. 50%) and partially based on the quality/accuracy of a subset of the assigned problems (approx. 50%). To receive credit for completion, problems must be presented using the full appropriate problem solving approach. The problems graded for accuracy will be evaluated in more detail looking for correct methods, accurate complete results, and clear and complete explanations as described above (where appropriate).
- In computing the overall homework grade, we will drop the two lowest homework scores. This is meant to provide some flexibility in dealing with a higher workload in another class or unexpected situation that prevents you from completing one or two of the assignments on time.

Course Policies

Grading errors: If you notice an error in grading of your assignment, you may use the regrade request function in Gradescope to briefly describe the technical error. Regrade requests for any exam or assignment must be submitted within 2 weeks of the grade posting to Canvas (or the last day of classes, whichever occurs first).

Office Hours: Instructor and TA office hours will be announced as soon as possible.

Email: We reserve the right to reply to email questions only during our regular working hours and when we are available, e.g., Monday through Friday, 9:00 am – 5:00 pm. Emails received 24 hours or less before the exams are not guaranteed a response. To better help us manage and track your emails please include **ASEN2003** at the beginning of the subject line.

Attendance: Attendance to lecture on Zoom or in-person is expected, but not required. Participation in laboratory sessions (either in-person or remote) is mandatory. In-class assignments may be given at any time and students are expected to come to class prepared to work with their team.

Exams: Exam dates are provided on the class schedule. If you cannot sit an exam due to an unavoidable schedule conflict, notify the instructor at least one week prior to the exam date to make arrangements for an alternate test date. If you cannot take an exam due to illness or other emergency situation occurring on the exam date, notify the instructor as soon as possible so that an appropriate course of action can be arranged.

Instructions on what materials may be used for exams will be provided by the instructors. Any type of student communication, collaboration or copying on any exam constitutes cheating and will result in an F for the entire course. An honor code violation report will be filed.

Lab Reports: Experimental and design lab exercises are conducted and submitted together with your team. Contributions of each team member will be identified for each exercise. Collaborations with other teams, including shared diagrams or extensive discussion of results must be acknowledged. A grading rubric is provided with each lab.

Deadlines: Deadlines (including time and date) will be clearly listed on each assignment. If an extenuating circumstance occurs and you are unable to submit an assignment by the deadline, please contact the instructor as soon as you are able to by email. A hectic schedule or crashed computer is not an acceptable reason for a late lab submission. Except in extenuating circumstances, late assignments will not be graded and will not receive any credit. No opportunities for extra credit will be provided.

Grading: Grades on individual assignments and for the overall course are set based on the following criteria. **Grades do not correspond to pre-specified ranges of scores.**

A, A- Demonstrates superior understanding of the material beyond the course requirements, excellent technical work
B+, B Demonstrates comprehensive understanding of material, very strong technical work
B-, C+ Demonstrates good understanding of the material, complete technical work
C Demonstrates adequate understanding of the material to proceed to the next level; sufficient technical work
C- Does not demonstrate adequate understanding of material to proceed to the next level
D Poor technical work
F Unsatisfactory performance

To receive a course grade of C or better, a student must earn a C or better on the individual grade in this class. A C is the minimum grade that allows you to proceed to a course for which this is a prerequisite. If the weighted exam and final score is below a C, the student's individual score will be assigned as their final grade in the course. In this case the group assignments will not contribute to the final grade. See the grading table below for specific weightings.

Grade Policy

The final grade in this course will be calculated using the following rubric:

Type	Description	Percentage
Individual Grade	Unit Exams (4)	60%
	Final Exam	40%
	Individual Total	100%
Group Grade	Labs	70%
	Homework	30%
	Group Total	100%
Final Grade	If individual grade >= C*	Final = 0.6*Individual + 0.4*Group
	If individual grade < C*	Final = Individual

*The threshold individual grade for a C will not be higher than 70.

Grading Philosophy

Assignments are graded to an absolute standard designed to indicate your level of competency in the course material. Minor adjustments may be made in the assignment of final grades, but there is a limited amount of "curving" in the course. The final grade indicates your readiness to continue to the next level in the curriculum. The AES faculty have set these standards based on our education, experience, interactions with industry, government laboratories, others in academe, and according to the criteria established by the ABET accreditation board.

The course grade is primarily dependent on individual measures of competency, i.e. exams. The other course assignments are designed to enrich the learning experience, build additional skills, and enhance individual performance, not to substitute for sub-standard individual competency. Accordingly, group assignment grades are only incorporated into the final grade when the individual grade is a C or better. In other words, if your individual average is below a C, the group-based grade fraction will not be averaged into your final grade, which will then be based solely on your individual score. This policy makes it important to use the group assignments 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. Homework is included in the group grade because collaboration is encouraged; it does not mean that copying is permitted on homework.

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, 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.

CU Boulder currently requires masks in classrooms and laboratories regardless of vaccination status. This requirement is a precaution 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.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu).

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

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university 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 university policies, reporting options, and the 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 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. 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. In this class, please provide us with a list of these conflicts in the first two weeks of the semester.

See the campus policy regarding religious observances for full details.