

PHY 420: Classical Mechanics (Spring 2022, CRN 27736)

Instructor: Dr. Eric Edlund

SUNY Cortland, Physics Department

Course Meeting Times and Location

Times: MW 4:00 PM – 5:15 PM

Location: Bowers 1113

Contact Info

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Office: Bowers 133

Preferred contact method is email.

Standing Office Hours

Monday 10:00 AM – 12:00 PM

Tuesday 12:00 PM – 1:00 PM

Wednesday 12:00 PM – 1:00 PM

Friday 11:00 AM – 12:00 PM

Or by appointment:

If you are unable to attend these standing office hours or would like to speak privately, you are encouraged to make an appointment.

Course Description

The study of the motion of physical bodies at the macroscopic level. Topics include the dynamics of a particle, the harmonic oscillator, motion in three dimensions, central forces, systems of particles and rigid bodies.

Student Learning Outcomes

Upon successful completion of the course, students will be able to:

1. Recall and apply the core principles of classical mechanics.
2. Recall and apply the mathematical methods of solution in classical mechanics.

Scope of Course

This course revisits and builds on the major themes of Physics 201, 202, & 203 using advanced analysis techniques. The subject matter of this course will be roughly divided into five modules, each of about three weeks in length:

Module I: Waves, oscillations, damping, and resonance

Module II: Motion in non-inertial reference frames

Module III: Law of universal gravitation, orbits, and docking maneuvers

Module IV: Lagrangian and Hamiltonian mechanics

Module V: Solid body rotation

Prerequisites

This course has official prerequisites of PHY 202 and MAT 237 (Calculus III). More importantly, this course requires a strong foundation in the basics of mechanics. If your background in these essentials is insufficient for this course you may need to invest extra work to come up to speed.

Required Materials

1. *Analytical Mechanics (7th edition)*, by Fowles and Cassiday. ISBN 0534494927.
2. A dedicated notebook for this course.

My Expectations

Classical Mechanics is a math-intensive course where you will be exposed to new ways of thinking about familiar problems. Success in this course will require an honest effort on your part, attendance in class, serious reading of the textbook, and perseverance. You may find that you have to attempt homework problems more than once to get it. I expect that you will need to invest the full 9 hours per week of time suggested by the College, outside of class, to master this material. If your background in some topics is rusty then you may need to invest additional effort for success. Given that, I expect that you will

- attend PHY 420 ready to build on a foundation of prior knowledge of physics;
- be proactive about coming up to speed on material that you need to review;
- put in a serious effort on the HW, which means that you do not resort to Chegg for answers;
- that you ask questions in class or in office hours when you get stuck;
- that you plan ahead and leave plenty of time to work on problem sets so that you provide yourself sufficient time to ask questions in advance of the due date;
- and that you come to class prepared, having read the assigned texts, ready to learn and excited to think more deeply about the nature of the universe.

Grade Assessment

Notes

Participation	10%	5% for attendance and 5% for in-class participation
Homework	50%	There will be 10 problem sets
Quizzes	25%	5 quizzes, each worth 5%
Final Exam	15%	Comprehensive final

Final course grades will be awarded using the following table.

	$76.7\% \leq \mathbf{C+} \leq 79.9\%$	$\mathbf{E} \leq 59.9\%$
$93.4\% \leq \mathbf{A}$	$73.4\% \leq \mathbf{C} \leq 76.7\%$	
$90.0\% \leq \mathbf{A-} \leq 93.3\%$	$70.0\% \leq \mathbf{C-} \leq 73.3\%$	
$86.7\% \leq \mathbf{B+} \leq 89.9\%$	$66.7\% \leq \mathbf{D+} \leq 69.9\%$	
$83.4\% \leq \mathbf{B} \leq 86.6\%$	$63.4\% \leq \mathbf{D} \leq 66.6\%$	
$80.0\% \leq \mathbf{B-} \leq 83.3\%$	$60.0\% \leq \mathbf{D-} \leq 63.3\%$	

Important Dates

Monday 1/24	First day of classes
Friday 1/28	End of the add/drop period
Monday 3/14 to Friday 3/19	----- Spring Break -----
Friday 5/6	Last day of classes
Monday 5/9	Final Exam, 4:00 PM – 6:00 PM

Description of Course Design and Policies

Online coordination: All documents will be shared through Microsoft Teams. The name of our team for this course is **PHY 420 – Spring 2022** and can be found by searching for the team using code **r4fp9ji**. Please keep an eye on the main page for announcements and look for relevant files, including problem sets, under the files tab.

Attendance and participation: Your final course grade includes 10% for attendance and participation, at 5% each. Each day of lecture will count equally toward the total attendance grade. The 5% for participation is a quality component that is based on your participation in discussion and in working problems in class.

Homework: Problem sets will be assigned approximately every week and due the following week, as indicated in the schedule. The official due date will be posted at the top of each problem set file, which can be found in the files area in the PHY 420 team.

Each problem set will have a Part I and a Part II. The first part will typically ask you to watch a video and comment on what you learned or observed. This part is meant to illustrate the connections between our studies and diverse subjects. Each question in the first part will be graded on a 0/1 basis for completeness. The second part is the traditional physics problem set, composed of a set of problems from the textbook.

The first problem set is a review of introductory physics material, and will be graded on a 0/1 basis for each question. For all other problem sets that require a presentation of worked solutions, the problems will be as follows.

Introductory problem: 2 pts each

- 0 pts = did not attempt or insufficient
- 1 pts = nearly correct solution
- 2 pts = fully correct solution

Challenge problem: 4 pts each

- 0 pts = did not attempt or insufficient
- 1 pts = incomplete/incorrect outline of ideas/methods
- 2 pts = correct solution developed but with substantial flaws
- 3 pts = nearly correct solution
- 4 pts = fully correct solution

Quizzes: There will be five quizzes throughout the semester. These are meant to serve as feedback for both of us about what you are most successful in understanding the material, and will also provide you with insight into what I think is important for the final exam. Quizzes will consist of 1 or 2 problems, which will be very similar to problems you have seen on recent problem sets.

Final Exam: The final exam will be comprehensive, though it will emphasize material from Module IV. Some of the problems will be drawn from your homework or prior exams, others will be new. You may bring your textbook to the exam (no electronic versions, printed copies only), but otherwise no notes, calculators or other aids can be used. No late exams will be permitted without a valid reason, as outlined in the university catalog.

Course Schedule

This is a tentative schedule and is subject to change as necessary.

Week	Dates	Topic	Chapter	Module	P-set
1	1/24 & 1/26	Review of PHY 201, 202, & 203	1		
2	1/31 & 2/2	Ballistic trajectories with drag	2	I	#1
3	2/7 & 2/9	Introduction to oscillations, Quiz 1	3	I	#2
4	2/14 & 2/16	Oscillations with damping	3	I	#3
5	2/21 & 2/23	Resonance, Quiz 2	3	I	#4
6	2/28 & 3/2	Non-inertial reference frames	5	II	
7	3/7 & 3/9	N.I. reference frames cont., Quiz 3	5	II	#5
8	3/14 & 3/16	<SPRING BREAK>			
9	3/21 & 3/23	Law of universal gravitation	6	III	
10	3/28 & 3/30	Orbital dynamics	6	III	#6
11	4/4 & 4/6	Orbit intercept, Quiz 4	6	III	#7
12	4/11 & 4/13	Lagrangian mechanics	10	IV	
13	4/18 & 4/20	Lagrangian mechanics	10	IV	#8
14	4/25 & 4/27	Lagrangian mechanics, Quiz 5	10	IV	#9
15	5/2 & 5/4	Motion in 3D	8 & 9	V	#10
16	5/9	Final Exam, Monday 4:00-6:00			

An important note about due dates:

The final column in the schedule indicates the week in which the indicated problem set will be due. All problem-sets, except for the last, are due at the start of class on Monday of the week indicated. The final problem set (#10), will be due at noon on Friday of the last week of the course.

An important note about chapters not covered:

Chapters 1, 4 and 7 will not be explicitly covered in this course, but that does not mean that they are unimportant! The first week of the course is meant to be review of past material and will not directly address Chapter 1 content, though there is substantial overlap here. You are encouraged to study Chapter 1 (a review of mathematical methods) as soon as possible. Chapter 4 concerns potential functions in 3 dimensions. Elements of chapter 7 (systems of particles, including momentum conservation and scattering) will be incorporated as time permits.

SUNY Cortland Policies and Statements

Academic Integrity Statement: All students are expected to uphold academic integrity standards. Plagiarism is defined as taking the ideas of others and using them as one's own without due credit. Students who cheat in examinations, course assignments, or plagiarize in this course may be disciplined in accordance with university rules and regulations. SUNY Cortland College Handbook, Chapter 340.

Disability Statement: As part of SUNY Cortland's commitment to a diverse, equitable, and inclusive environment, we strive to provide students with equal access to all courses. If you believe you will require accommodations in this course, please place a request with the Disability Resources Office at disability.resources@cortland.edu or call 607-753-2967. Please note that accommodations are generally not provided retroactively so timely contact with the Disability Resources Office is important. All students should consider meeting with their course instructor who may be helpful in other ways. SUNY Cortland College Handbook, Chapter 745.

Diversity Statement: SUNY Cortland is dedicated to the premise that every individual is important in a unique way and contributes to the overall quality of the institution. We define diversity broadly to include all aspects of human difference. The College is committed to inclusion, equity, and access and thus committed to creating and sustaining a climate that is equitable, respectful and free from prejudice for students, faculty and staff. We value diversity in the learning environment and know that it enhances our ability to inspire students to learn, lead and serve in a changing world. We are committed to promoting a diverse and inclusive campus through the recruitment and retention of faculty, staff and students. As a community, we hold important the democracy of ideas, tempered by a commitment to free speech and the standards of inquiry and debate. To this end, we are dedicated to developing and sustaining a learning environment where it is safe to explore our differences and celebrate the richness inherent in our pluralistic society. SUNY Cortland College Handbook, Chapter 130.

Inclusive Learning Environment Statement: SUNY Cortland is committed to a diverse, equitable and inclusive environment. The course instructor honors this commitment and respects and values differences. All students enrolled in this course are expected to be considerate of others, promote a collaborative and supportive educational environment, and demonstrate respect for individuals with regard to ability or disability, age, ethnicity, gender, gender identity/expression, race, religion, sex, sexual orientation, socio-economic status or other aspects of identity. In an environment that fosters inclusion, students have the opportunity to bring their various identities into conversation as they find helpful, but are not expected to represent or speak for an entire group of people who share aspects of an identity. If you have any questions or concerns about this statement, contact the Institutional Equity and Inclusion Office at 607-753-2263. <http://www2.cortland.edu/about/diversity/>

Title IX Statement: Title IX, when combined with New York Human Rights Law and the New York Education Law 129-B, prohibits discrimination, harassment and violence based on sex, gender, gender identity/expression, and/or sexual orientation in the education setting. The federal Clery Act and NY Education Law 129-B provide certain rights and responsibilities after an incident of sexual or interpersonal violence. When a violation occurs, victims and survivors are eligible for campus and community resources. Where the College has jurisdiction, it may investigate and take action in accordance with College policy. If you or someone you know wishes to report discrimination based in sex, gender, gender identity/expression, and/or sexual orientation, or wishes to report sexual harassment, sexual violence, stalking or relationship violence, please contact the Title IX Coordinator at 607-753-4550, or visit <http://www2.cortland.edu/titleix> to learn about all reporting options and resources.

Updated by SUNY Legal on February 1, 2018.