

# PHY 429: Advanced Classical Mechanics (Spring 2020, CRN 26385)

Instructor: Dr. Eric Edlund

SUNY Cortland, Physics Department

## Course Meeting Times & Location

Lecture: MW 2:00 – 2:50

Room: Bowers 1113

## Standing Office Hours

Monday 9:00 AM – 10:00 AM

1:00 PM – 2:00 PM

Wednesday 9:00 AM – 10:00 AM

Thursday 3:00 PM – 4:00 PM

Friday 12:30 PM – 1:30 PM

## Contact Info

Email: eric.edlund@cortland.edu

Phone: 753-5697

Office: Bowers 133

Preferred contact method is email.

## **Or by appointment:**

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

## Course Catalog Description

Optimization problems, variational calculus, orbital mechanics, introduction to fluid mechanics.

Admission is my special permission only. 2 credit hours.

## Scope of Course

This is a special topics course that is a continuation of the discussion in PHY 420: Classical Mechanics. The content of this course is roughly specified by the content areas defined in the course description, but is also open to input from students.

## Assessment Weighting

Participation 40%

Homework 60%

## Course Grade Scale

76.7% ≤ C+ ≤ 79.9%

73.4% ≤ C ≤ 76.7%

93.4% ≤ A ≤ 96.7%

90.0% ≤ A- ≤ 93.3%

70.0% ≤ C- ≤ 73.3%

86.7% ≤ B+ ≤ 89.9%

66.7% ≤ D+ ≤ 69.9%

83.4% ≤ B ≤ 86.6%

63.4% ≤ D ≤ 66.6%

80.0% ≤ B- ≤ 83.3%

60.0% ≤ D- ≤ 63.3%

E ≤ 59.9%

## Required Materials

1. *Analytical Mechanics (7<sup>th</sup> edition)*, by Fowles and Cassiday, published by Brooks Cole.

2. A dedicated notebook.

## Goals of the course

This special topics course will build on the foundational concepts from PHY 420, taking a deeper look, at some of the problems we encountered there and turning up the difficulty. We will work many problems together in class and with a goal of developing a better sense of how to frame questions, and develop analytical and/or approximate solutions. We will also broaden our scope to include an introduction to fluid dynamics and possibly other topics of interest to the students.

## Student Learning Outcomes

Based on the course description, we define a set of general student learning outcomes that we will take as goals for the course. Upon successful completion of this course, students will be able to:

- use Lagrangian and Hamiltonian analysis to represent physical systems, and more generally, to be able to use variational calculus to define optimization problems.
- describe gravitational orbits in terms of solutions to the universal law of gravitation, and to be able to calculate thrust vectors required for orbital transfer maneuvers.
- understand the meaning of the Navier-Stokes equation in describing fluid dynamics, and to be able to calculate basic properties of flows in simple geometries.
- be able to discuss complex problems and effectively communicate the process of analysis involved in developing an understanding of these problems.

The content of the course is somewhat flexible and there is a very large range of problems that can be explored. These goals are really quite modest, and things like having an understanding of the Navier-Stokes equation (fluid dynamics) should be interpreted as an introductory understanding of this content area since this is likely students' first exposure to these concepts.

## Course Policies

**Attendance:** Since this course is built around regular discussion, your regular attendance is required. You will be allowed one unexcused absence without consequence. Any absences after the first will be assigned a penalty of 4% to the final score.

**Homework:** The primary weighting of this course is on the home work. Problem sets will have few problems that are hefty and require a serious effort to solve. These problems will be closely aligned with the content discussion in lecture. You are free, and encouraged, to collaborate with your peers, as long as the submitted work is truly your own.

**Midterm Exams:** There will be no exams in this course.

**Final Exam:** We will meet during the final exam time and hold this is a final discussion. Each student will present a problem for the class. This presentation will count toward your participation credit for the course.

**Report:** Students enrolled in the 529 section of this course will have an extra assignment (compared to those in the 429 section). This will consist of a problem of the student's design, and be presented with a full analysis. Full credit should include a comparison of both approximate and exact solutions.

### Important Dates

Friday 1/31	End of the add/drop period
5/11 – 5/15	Final exam period, time TBD (presentations only, no exam)

### Course Schedule

Note that this is a tentative schedule and is subject to change as necessary and by input from the students.

Week	Dates	Topic	Chapter	P-Set
1	1/27 to 1/31	Rev. of Lagrangian/Hamiltonian analysis	10	
2	2/3 to 2/7	Variational calculus	10	
3	2/10 to 2/14	Variational calculus	10	#1
4	2/17 to 2/21	Optimization problems	-	
5	2/24 to 2/28	Optimization problems	-	#2
6	3/2 to 3/6	Universal law of gravitation	6	
7	3/9 to 3/13	Gravitational orbits	6	#3
8	3/16 to 3/20	<b>SPRING BREAK</b>	---	---
9	3/23 to 3/27	Orbital transfer maneuvers	6	
10	3/30 to 4/3	Introduction to fluid dynamics	-	#4
11	4/6 to 4/10	Viscosity & Reynolds number	-	
12	4/13 to 4/17	Pipe flow	-	#5
13	4/20 to 4/24	Open topic	-	
14	4/27 to 5/1	Open topic	-	
15	5/4 to 5/8	Open topic	-	#6
16	5/11 to 5/15	<b>Final Exam</b> (presentations)		

## 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](mailto: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.