Phys 339

Mechanics

MWF, 9:15, Kaneko 110
Fall 2020

Jed Rembold, Ph.D

jjrembold@willamette.edu
`willamette.edu/~jjrembold`
Collins 311
Office Hours: MW 3:15-5, or catch me anytime online!
Phone: (503) 370-6860

This syllabus is subject to change or adaptation as the semester progresses. (Particularly the schedule. . .)

Course Description: The intent of this course is to extend beyond an introductory mechanics course to further explore the concepts of classical mechanics. Particular attention will be paid to the reformulation of classical mechanics by Lagrange. Topics will include 3 dimensional kinematics and dynamics in various coordinate systems, two-body problems, oscillations, non-inertial reference frames, and rigid body motions. An emphasis will be placed on the use of computational modeling and visualization throughout the class.
Prerequisite(s): Phys 222 and Math 249
Note: A minimum grade of C- is required for this course to count toward university credit.
Credits: 1.0

Text: *Classical Mechanics*
Author: John R. Taylor
ISBN-13: 9781891389221

Course Objectives:
Over the semester, students will gain a working knowledge in:

1. Multidimensional kinematics and dynamics
2. Working in cartesian, cylindrical and spherical coordinates
3. Using the ideas of Lagrange to determine equations of motion
4. Solving equations of motion using both analytic and numeric methods
5. Use of computers to aid in solving, visualizing, and checking solutions
6. Applications in oscillations, rigid bodies, orbits and chaos

Moreover, physics is a field that requires intense problem solving. By the end of the semester students will have further honed various methods of problem solving and practiced using different computational tools to assist them.

Grade Distribution:

Homework	35%
CompDays	15%
Midterm	15%
Final Project	15%
Final Exam	20%

Letter Grade Distribution:

>= 92.00	A	72.00 - 77.99	C
90.00 - 91.99	A-	70.00 - 71.99	C-
88.00 - 89.99	B+	68.00 - 69.99	D+
82.00 - 87.99	B	62.00 - 67.99	D
80.00 - 81.99	B-	60.00 - 61.99	D-
78.00 - 79.99	C+	<= 59.99	F

Student Learning Objectives (SLO):

- To have a broad theoretical understanding of solving multidimensional, complex problems in classical mechanics, in particular through use of the Lagrangian. Demonstrated through written homework, a final project, and two exams.
- To have a functional working knowledge of using computer software to assist in the solving, visualization, and checking of complex physical problems. Demonstrated through written homework, a final project and two exams.
- To be able to setup problems symbolically, using an appropriate problem solving strategy with necessary mathematical methods to solve physical problems, and to communicate and interpret those solutions visually, numerically, and verbally. Demonstrated though lecture participation, homework, and the final project.

Course Assessment:

- **Homework**
  - Written: Homework will be assigned each week and will be due at midnight the following Monday (see schedule). Homework will be a combination of problems drawn from the text and created by myself, with problem sets generally having 3-5 problems. Homework should be written up nicely and legibly. This class is largely homework based, so please ensure that you are keeping up and turning in the problem sets! Due to the length of time it generally takes me to grade a mechanics problem, I will be adopting a policy where I will only randomly grade 2 problems from each assignment. (And it is a true random, so I recommend against trying to "game" the system!) If I see anything obviously wrong with the other problems, I'll comment on it so that you are aware, but the score is only based off the two randomly graded problems. I will keep a copy of the solutions in my office that you can check your other solutions against if you want to ensure you are completing the non-graded problems correctly.
  - Monday Workshops: To better provide experience, assistance and troubleshooting for computational type problems, most Mondays will be reserved for a challenging computational type problem. I'll generally introduce the problem and show some examples of

how to approach it, and then students can work in groups on their laptops to determine their solutions while I roam and assist and offer advice. The goal is to improve your comfort and skill at using computational methods and computers to aid you in solving and presenting a solution. As such, you will also be expected to submit your complete worked solution as a notebook by the following Wednesday at midnight. Presentation matters, and using technology to clearly show how you worked through a problem benefits both yourself and your readers!

  - General Info: Physics is a problem solving discipline, and the best method to gain proficiency is solving problems. There are no real "shortcuts". The number and length of problems assigned is my best estimate for having you adequately practice and learn the material without being an excessive burden on your time. Working in groups and helping others is very encouraged, though students should turn in their own work. I highly recommend helping and instructing other classmates if you feel proficient on a topic, both to help them and because there is no better way to identify gaps in your own knowledge than when you attempt to teach something.

- **Tests**
  - As most of you are physics majors, I see less of a need to attempt to motivate learning through the use of tests. You should be motivating your own learning at this point. Thus, there will be only two tests spaced throughout the semester: a midterm and a final. Due to the length and complexity of many classical mechanics problems, tests will be take home, with approximately a week to complete each, as I realize you have other demands on your time. Tests will be open-book, open-note, and computers can be used (and are in fact often encouraged) to help solve problems.

- **Attendance**
  - While attendance will not be graded in this class, I heartily encourage you to show up. I work hard to attempt to make lectures useful, engaging, and fun, and would much prefer feedback if I'm not meeting your needs rather than you vanishing from the classroom.

Course Policies:

Late Work Policy

I understand that sometimes things come up and you are unable to get an assignment in on time, and I strive to be incredibly flexible and accepting of late work. However, there also comes a point when you get too far behind to realistically keep up with the class. In an effort to compromise between the two, my late policy allots you 20 cumulative days of late work throughout the entire semester across both written homework and computation day submissions. So you can turn 20 assignments in one day late, 2 assignments in 10 days late, etc. without penalty. Once you have used up your 20 days, any further late assignments will immediately be worth only 50% of their total possible points.

Incomplete Policy

An incomplete grade will only be granted in the case of prolonged illness or family emergencies that remove the student from the campus for an extended time period during the semester. Under no situations will an incomplete be granted due to a student falling behind through lack of motivation, understanding, or time management skills. If you are concerned about your progress and how you are doing in the class, please come visit me! We can sort out where you are struggling and work out a plan to get you back on track.

Willamette Policies:

Academic Honesty

Cheating is defined as any form of intellectual dishonesty or misrepresentation of one's knowledge. Plagiarism, a form of cheating, consists of intentionally or unintentionally representing someone else's work as one's own. Integrity is of prime importance in a college setting, and thus cheating, plagiarism, theft, or assisting another to perform any of the previously listed acts is strictly prohibited. An instructor may imposed penalties for plagiarism or cheating ranging from a grade reduction on an assignment or exam to failing the course. An instructor can also involve the Office of the Dean of the College of Liberal Arts for further action. For further information, visit: http://www.willamette.edu/cla/catalog/resources/policies/plagiarism_cheating.php.

Time Commitments

Willamette's Credit Hour Policy holds that for every hour of class time there is an expectation of 2-3 hours work outside of class. Thus, for a class meeting three days a week you should anticipate spending 6-9 hours outside of class engaged in course-related activities. Examples include study time, reading and homework, assignments, research projects, and group work.

Disability and Diversity

Willamette University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the professor as soon as possible. Students with disabilities are also encouraged to contact the Accessible Education Services office in Matthews 103 at 503-370-6737 or accessible-info@willamette.edu to discuss a range of options to removing barriers in the course, including accommodations.

Tentative Course Outline:

The weekly coverage might change as it depends on the progress of the class but I will keep you informed. I *highly* recommend you follow along with the reading, as the lectures will be more focused on reinforcing concepts and clearing up misconceptions about topics you should have learned from the reading!

Week	Date	Chapter	Description	Due
1	Aug 24	Ch 1	Newtons Laws of Motion	
	Aug 26	Ch 1	Newtons Laws of Motion	
	Aug 28	Ch 2	Projectiles and Charges Particles	
2	Aug 31		CompDay 1: Intro	HW1
	Sep 02	Ch 2	Projectiles and Charges Particles	CompDay 1
	Sep 04	Ch 3	Momentum and Angular Momentum	
3	Sep 07		CompDay 2: Projectile Motion	HW2
	Sep 09	Ch 3	Momentum and Angular Momentum	CompDay 2
	Sep 11	Ch 4	Energy	
4	Sep 14		CompDay 3: Rockets	HW3
	Sep 16	Ch 4	Energy	CompDay 3
	Sep 18	Ch 4	Energy	
5	Sep 21		CompDay 4: Sympy and Energy	HW4
	Sep 23	Ch 5	Oscillations	CompDay 4
	Sep 25	Ch 5	Oscillations	
6	Sep 28		CompDay 5: 2D Oscillators	HW5
	Sep 30	Ch 6	Calculus of Variations	CompDay 5
	Oct 02	Ch 7	Lagrange's Equations	
7	Oct 05		CompDay 6: Fourier Series	HW6
	Oct 07	Ch 7	Lagrange's Equations	CompDay 6
	Oct 09	Ch 7	Lagrange's Equations	
8	Oct 12		CompDay 7: Lagrangians with Sympy	
	Oct 14	Ch 7	Lagrange's Equations	CompDay 7
	Oct 16	Ch 8	Two-Body Central Force Problems	
9	Oct 19		CompDay 8: Binar Star Orbits	HW7
	Oct 21	Ch 8	Two-Body Central Force Problems	Midterm
	Oct 23	Ch 9	Mechanics in Noninertial Frames	
10	Oct 26		CompDay 9: Hohmann Transfers	HW8
	Oct 28	Ch 9	Mechanics in Noninertial Frames	CompDay 8, CompDay 9
	Oct 30	Ch 10	Rotational Motion of Rigid Bodies	
11	Nov 02		CompDay 10: Coriolis Merry-Go-Round	HW9
	Nov 04	Ch 10	Rotational Motion of Rigid Bodies	CompDay 10
	Nov 06	Ch 10	Rotational Motion of Rigid Bodies	
12	Nov 09		CompDay 11: Inertial Tensors	
	Nov 11	Ch 10	Rotational Motion of Rigid Bodies	CompDay 11
	Nov 13	Ch 11	Coupled Oscillators	
13	Nov 16		CompDay 12: Visualizing Oscillation Modes	HW10
	Nov 18	Ch 11	Coupled Oscillators	CompDay 12
	Nov 20	Ch 11	Coupled Oscillators	
	Nov 23		Final Project Readings	HW11