University of Wisconsin – Stevens Point

Dept. of Physics and Astronomy

Advanced Mechanics – PHYS 335

Spring 2023

Course Information

Course title: Advanced Mechanics **Course number:** PHYS 335

Instructor: Maryam Farzaneh **Contact:** B105 Science Building, mfarzane@uwsp.edu

Class times: Monday, Wednesday, Friday 10:00 – 10:50 am, SCI-A210

Pre-requisites: Phys 250, Math 227, Math 230 (not necessary)

Textbook: *Classical Mechanics*, John R. Taylor, University Science Books.
ISBN-13: 978-1-891389-22-1.

Office hours: MTR: 2:00 – 3:00 pm

If you cannot make any of the above office hours, **please know that I have an open-door policy. Please stop by as often as you wish or make an appointment by emailing me**.

Course Description and Objectives

In Advanced Mechanics we study classical Newtonian mechanics with more rigor and mathematical sophistication compared to your introductory physics courses. In this course we will study Newton's Laws using vectors and differential equations in both Cartesian and polar coordinates. We will revisit momentum, angular momentum and energy conservation laws and will study oscillations in detail. A new approach to classical mechanics, called Lagrangian Mechanics will be introduced and will be used to study central forces and many more examples. We will also study motion in non-inertial frames and investigate the rotational motion of rigid bodies.

By the end of the course, you should be able to achieve the following objectives:

1. Gain an in-depth understanding of Newtonian Mechanics, especially Newton's Laws, and apply these laws in Cartesian and polar coordinates.
2. Learn to solve differential equations of motion and determine velocity and position of a particle, given the initial conditions.
3. Understand damped and driven oscillation of a mass.
4. Learn Lagrangian Mechanics and be able to apply its results in different situations.
5. Learn to work out problems in a non-inertial frame of reference.
6. Understand the rotation of a rigid body.

Lecture participation
I strongly encourage you to attend *all* the lectures and take detailed notes. Sometimes the lecture covers more material than you might find in your textbook. However, the only way to master an upper-level subject in physics is to read the text carefully (more than once) and consult other books and not solely rely on your class notes.

Homework
There will be one homework set per week, which is due at the beginning of the class period on the day indicated on the assignment**. For your solutions, please follow the format summarized in the "Homework Guidelines" that I will hand out to you on the first day of class. I will not grade the homework assignments which deviate significantly from this format.**

I will post the solutions to the entire homework assignment on Canvas right after all homework assignments are submitted. **If you need an extra day or two to finish your homework, please let me know. I generally grant extensions. However, I do not accept assignments which are unreasonably late, unless you have talked to me about the situation in advance.** *Homework counts for 40% of your final grade.*

Exams
There will be *two* midterm exams during the semester, not counting your final exam. These exams will be held **on weeks 5 and 10 (please see the course schedule) and are take-home exams (Exams will be posted on Canvas)**. I will give you 24 hours to finish each exam and submit it on Canvas. The final exam is non-cumulative and is also take home with 24-hour time limit. The Final exam will be posted on Canvas on **Tuesday, May 16, at 10:00 am**. *Overall, these three exams count for 60% of your grade (20% for each exam).*

Grading and Evaluation
I will calculate your grade based on a weighted percentage of your scores as follows:

Homework	40%
Exams (2 midterms, 1 Final)	60% (20% each exam)

Your final grades will be determined as follows:

93% and above	A	87--89%	B+	77--79%	C+	67--69%	D+
90--92%	A-	83--86%	B	73--76%	C	60--66%	D
		80--82%	B-	70--72%	C-	below 60%	F

Please note that I do *not* grade on a curve. Grades will be rounded up. For example, 85.6% will become an 86% (A-), but 85.3% will remain a B+.

General Course Policies

- **Disability services**

  UWSP is committed to providing reasonable and appropriate accommodations to students with disabilities and temporary impairments. If you have a disability or acquire a condition during the semester where you need assistance, please contact the Disability Resource Center (DRC) located at 108 Collins Classroom Center (CCC) as soon as possible. DRC can be reached at 715-346-3365 or at drc@uwsp.edu.

- **Academic misconduct**

  As a student at UWSP, I expect you to be familiar with the Chapter 14 of the UWSP policy document on Academic Misconduct (especially Section 14.03) found here: https://www3.uwsp.edu/dos/Pages/Student-Conduct.aspx.

  Simply put, ***do not*** copy each other's homework, lab reports and exams and pass them off as your own. Any confirmed incidence of academic misconduct, including plagiarism and other forms of cheating will be treated seriously and in accordance with the University policy.

- The schedule for the final exam is set by the University. I will not schedule an early final exam for whatever reason.

- **I *do not* assign work for extra credit. There are *no* bonus points that you can earn.**

- Once you hand in your final exam, there is nothing more you can do to change your grade.

Tentative Course Schedule

The tentative course schedule is as follows. This might change, and I will try my best to announce any changes beforehand.

Week	Chapter and Topic	Comments
(1)	(1) Space, time, mass and force, Newton's laws, Inertial frames, Conservation of momentum	HW1
(2)	(1) Newton's 2nd law in Cartesian and polar coordinates	HW2
(3)	(2) Projectile motion with linear drag	HW3
(4)	(3) Conservation of momentum, Rocket motion, Center of mass, Conservation of angular momentum	HW4
(5)	(4) Work, KE, Conservative forces, PE, Conservation of mechanical energy, Non-conservative forces, Force and PE, Gradient and curl, Energy in one dimension, Graphs of PE	**Exam 1**
(6)	(5) Oscillations: SHM, Damped oscillation, Driven damped oscillation, Resonance	HW5
(7)	(6) Calculus of variations, Brachistochrone, Generalized coordinates	HW6

(8)	(7) Lagrange's equations – Projectile motion, Simple pendulum, Pendulum supported on a wheel, Pendulum with oscillatory support, Bead on a rotating hoop	HW7
	SPRING BREAK	
(9)	(8) Central forces, Equation of motion, Effective potential, Equation of the orbit	HW8
(10)	(8) Kepler orbits, Bounded orbits, Period of orbits, Unbounded Kepler orbits	**Exam 2**
(11)	(9) Motion in non-inertial frames, Accelerating frames, Tides, Rotating frames	HW9
(12)	(9) Newton's Laws in rotating frames, Centrifugal force, Free fall, Coriolis force	HW10
(13)	(9) Foucault pendulum (10) Rotational Motion of Rigid Bodies, CM review, Rotation about a fixed axis	HW11
(14)	(10) Moment of inertia, Rotation about any axis, Principal axes	HW12
(15)	Review, Q&A, catch up	Review Problems
(16)	**Final Exam: Tuesday, May 16, 10:00 am – Take Home**	