Course syllabus

Classical Mechanics

PHYS 410
Fall 2023

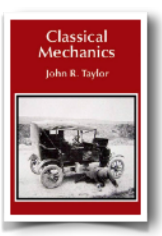
Overview

This course deals in depth with *Classical Mechanics*, the study of how things move in regimes for which Quantum or Relativistic mechanics are not needed (macroscopic objects traveling at speeds slow with respect to the speed of light).

The course will begin by revisiting **Newtonian mechanics** from a more advanced point of view than what one learns in introductory physics courses, including analytical solutions for the motion of particles with drag or with magnetic fields, and basic techniques of numerical solutions. The course will then present **Lagrangian mechanics**, covering many examples of systems that can best be solved using Lagrange's equations, including two-body central forces. The **Hamiltonian formulation of mechanics** will also be introduced. Other topics will include elasticity of solids, the rotational dynamics of rigid bodies, and chaos.

Since many of the differential equations and integrals that will be encountered do not have analytical solutions, throughout the course we will use numerical calculations and plotting based on **python**.

Textbooks



Classical Mechanics
John R. Taylor
University Science Books; 1st edition (2005)
ISBN: 978-1-891389-22-1

Classical Mechanics by John Taylor is the **required textbook** for this course. We will follow it closely, cover most of it, and assign some of the exercises problems therein.

Additionally, an alternative reference that you might find helpful is David Tong's lecture notes at http://www.damtp.cam.ac.uk/user/tong/dynamics.html.

For the python exercises, these basic introductions to **matplotlib**, **numpy**, and **scipy's odeint** can be useful.

Prof. Manuel Franco Sevilla
manuelf@umd.edu
Last name is "Franco Sevilla" following Spanish tradition

Class meets
PHY #1204 (Toll bld.)
Tuesdays & Thursdays
11:00am – 12:15pm
Fridays 1:00pm - 1:50pm

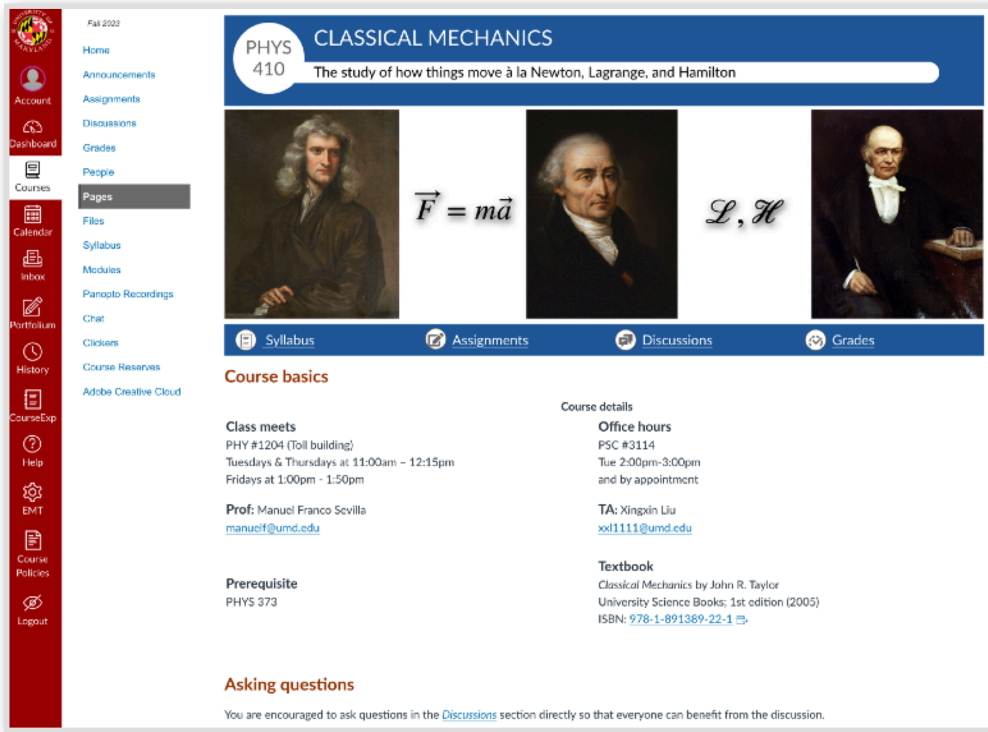
Office hours
PSC #3114
Tue 2:00pm-3:00pm
and by appointment

Teaching assistant
Xingxin Liu
xxl1111@umd.edu

Prerequisites
PHYS 373 (Math methods II)

Course communication
ELMS will be the primary source for class communication (homework posting and submission, lecture notes, grades, time-sensitive announcements) and to ask course questions that would benefit every one to hear. Email is the preferred way of communicating directly with me.

ELMS



ELMS will be the **primary source for class communication** (homework posting and submission, lecture notes, grades, time-sensitive announcements) and to ask course questions that would benefit every one to hear.

I will try to oversee the conversation and provide answers when I can, but **students are encouraged** to **both ask and answer questions themselves**.

Campus policies

It is our **shared responsibility** to **know and abide by the University of Maryland's policies** that relate to all courses, which include topics like:

- **Accessibility and accommodations**: we in UMD are committed to providing appropriate accommodations for students with disabilities. Students with a documented disability should inform me within the add/drop period if academic accommodations are needed.
- **Academic integrity**: the UMD Honor Code prohibits students from cheating, fabricating information, facilitating academic dishonesty, and plagiarism in any course. Consequences of academic dishonesty are severe if caught, and, in most cases, even if not caught right away or ever.
- **Student and instructor conduct**: students are responsible for upholding UMD's standards of conduct, and I am responsible for meeting the expectations for faculty providing undergraduate courses, such as providing a complete syllabus promptly, evaluating and sharing the student's performance throughout the course, or being reasonably available with regular office hours or by appointment.

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies and follow up with me if you have questions.

Grades

The final grade will be based on the following:

- **Homework (20%)**: weekly or bi-weekly homework, and the lowest two scores will be dropped
- **In-class exercises (5%)**
- **First midterm exam (15%)**
- **Second midterm exam (20%)**
- **Final exam (40%)**

"In mathematics you don't understand things. You just get used to them"
Von Neumann

This wise saying applies to pretty much everything, including Classical Mechanics. This is why homework is very important. You are encouraged to work on the homework in groups but the final solution write up should be entirely yours. Only a subset of the problems in each homework set will be graded, and this choice will only be made public after the homework is submitted.

Homework submission will be done online via ELMS (you can upload a typeset pdf file or a picture of your hand-written solution). After uploading your work for an assignment, **preview the file(s) uploaded in ELMS** as it is common to upload the wrong file.

Late work will not be accepted as solutions will be provided shortly after the deadline, so please plan to have it submitted well in advance. I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

In-class exercises will be distributed throughout the year. If you come to class and write something reasonable you will obtain full credit.

The **exams** are taken **in class** and are **strictly individual**. They determine the majority of the grade, so homework should be seen primarily as a means to learn the material and prepare for the exams.

Final letter grades are assigned based on the percentage of total assessment points earned. These percentages may be adjusted, but only in the downwards direction.

Highest possible final Grade Cutoffs									
+	95%	+	80%	+	65%	+	50%		
A	90%	**B**	75%	**C**	60%	**D**	45%	**F**	<40%
-	85%	-	70%	-	55%	-	40%		

Course schedule

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Week	Lec	Date	Topics	Book
1	**1**	Aug 29	Introduction	Ch. 1
	2	Aug 31	Newton's Laws	Ch. 1
	3	Sep 1	Projectiles and drag	Ch. 2
2	**4**	Sep 5	Charged particles	Ch. 2
	5	Sep 7	Momentum	Ch. 3
	6	Sep 8	Momentum	Ch. 3
3	**7**	Sep 12	Work-Energy Theorem	Ch. 4
	8	Sep 14	1D potentials	Ch. 4
	9	Sep 15	1D oscillator	Ch. 5
4	**10**	Sep 19	1D oscillator	Ch. 5
	11	Sep 21	1D oscillator	Ch. 5
	12	Sep 22	Midterm exam 1 review	
5	**13**	Sep 26	Midterm exam 1 review	
		Sep 28	**Midterm exam 1**	
	14	Sep 29	Lagrangian Mechanics	Ch. 7
6	**15**	Oct 3	Lagrangian Mechanics	Ch. 7
	16	Oct 5	Lagrangian Mechanics	Ch. 7
	17	Oct 6	Hamilton's Principle & Calculus of Variations	Ch. 6
7	**18**	Oct 10	Hamilton's Principle & Calculus of Variations	Ch. 6
	19	Oct 12	Hamilton's Principle & Calculus of Variations	Ch. 6
	20	Oct 13	Hamiltonian Mechanics	Ch. 13
8	**21**	Oct 17	Hamiltonian Mechanics	Ch. 13
	22	Oct 19	Hamiltonian Mechanics	Ch. 13
	23	Oct 20	Central Force Motion	Ch. 8

WEEK	LEC	DATE	TOPICS	BOOK
9	**24**	Oct 24	Central Force Motion	Ch. 8
	25	Oct 26	Central Force Motion	Ch. 8
	26	Oct 27	Central Force Motion	Ch. 8
10	**27**	Oct 31	Midterm exam 2 review	
		Nov 2	**Midterm exam 2**	
	28	Nov 3	Rigid Body Kinematics	Ch. 10
11	**29**	Nov 7	Rigid Body Dynamics	Ch. 10
	30	Nov 9	Rigid Body Dynamics	Ch. 10
	31	Nov 10	Rigid Body Dynamics	Ch. 10
12	**32**	Nov 14	Non-inertial frames	Ch. 9
	33	Nov 16	Non-inertial frames	Ch. 9
	34	Nov 17	Non-inertial frames	Ch. 9
13	**35**	Nov 21	Special topics	TBD
22-26 November - Thanksgiving				
14	**36**	Nov 28	Special topics	TBD
	37	Nov 30	Special topics	TBD
	38	Dec 1	Special topics	TBD
15	**39**	Dec 5	Special topics	TBD
	40	Dec 7	Exam review	
	41	Dec 8	Exam review	
Wednesday Dec 13, 8:00-10:00am - FINAL EXAM				