Course Syllabus – Spring 2023

Course Information

PHYS 3312.001 – Classical Mechanics
Spring 2023
SCI 3.230
Monday and Wednesday 11:30 am – 12:45 pm

Instructor and Teaching Assistant Contact Information

Associate Professor Michael Kesden
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Office Hours: Th 5:30 – 7:00 pm

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Office Hours: W 1:00 – 2:00 pm

Course Pre-requisites, Co-requisites, and/or Other Restrictions

This is a major core course for the BS/BA in Physics, and a requirement for the Geophysics Option for the BS in Geosciences. Students are expected to have completed PHYS 2325 – Classical Mechanics (or PHYS 2421 Honors Physics I) and the course pre-requisite PHYS 3411 – Theoretical Physics or their equivalents. Students are expected to be familiar with introductory mechanics, multivariable calculus, linear algebra, and ordinary differential equations. Students who have not completed these prerequisites or are unsure about their mathematical background should consult the instructor ASAP.

Course Description

PHYS 3312 Classical Mechanics (3 semester hours) Newtonian mechanics; oscillations; gravitation and central-force motion; Lagrangian and Hamiltonian dynamics; rotational dynamics and the inertia tensor; special relativity if time permits.

Student Learning Objectives/Outcomes

At the end of this course, students should be able to:

- Use Newton's laws to solve mechanics problems in Cartesian coordinates.
- Determine the motion of damped, driven simple harmonic oscillators.
- Understand the trajectories of a test particle moving under the influence of a central force such as gravity.
- Solve problems that require a functional to be minimized by using the calculus of variations.
- Set up the Lagrangian and Hamiltonian for systems using generalized coordinates, and derive the Euler-Lagrange and Hamilton's equations for these systems
- Specify the orientation of a rigid body using Euler angles.
- Calculate the inertia tensor of rigid bodies in a well-chosen coordinate basis.

- Use the Euler equations to determine the orientation of a rigid body as a function of time.
- Construct Lorentz invariants to calculate physical observables in special relativity.

Required Textbooks and Materials

Classical dynamics of particles and systems by Stephen Thornton and Jerry Marion, *any edition*.

This course will closely follow the presentation of the above topics in Marion and Thornton. I used the 4th edition myself as an undergraduate when taking a classical mechanics course many moons ago. A 5th edition has since been published, but it is almost indistinguishable. The book has been a valuable resource to me in my research throughout the years. A paperback version is available on Amazon, but you can also use an electronic version if you can get access to one.

Suggested Course Materials

Mechanics, Course of Theoretical Physics, Volume 1 by L. D. Landau and E. M. Lifshitz

This is the first of a classic 10-volume series on theoretical physics composed by Russian Nobel laureate Lev Landau in his head during the 1930's while serving in a NKVD (precursor to the KGB) prison. This material formed the basis of the "Theoretical Minimum" that Landau felt all theoretical physics should master. Only 43 candidates ever passed this exam in the history of the Soviet Union.

Textbooks and some other bookstore materials can be ordered online or purchased at the UT Dallas Bookstore.

Academic Calendar

This is a preliminary schedule subject to change at the discretion of the instructor.

WEEK/ DATES	TOPIC/LECTURE	READING	ASSESSMENT / ACTIVITY	DUE DATE
1 1/18	Introduction			
2 1/23 - 1/25	Newtonian Mechanics	Ch. 2		
3 1/30 2/1	Newtonian Mechanics Oscillations	Ch. 2 Ch. 3	HW #1	2/3
4 2/6 - 2/8	Oscillations	Ch. 3		

WEEK/ DATES	TOPIC/LECTURE	READING	ASSESSMENT / ACTIVITY	DUE DATE
5 2/13 2/15	Oscillations Gravitation	Ch. 3 Ch. 5	HW #2	2/17
6 2/20 - 2/22	Central-Force Motion	Ch. 8		
7 2/27 - 3/1	Central-Force Motion	Ch. 8	HW #3	3/3
8 3/6 - 3/8	Calculus of Variations	Ch. 6	Exam #1	3/10
3/14 – 3/16	SPRING BREAK!!!			
9 3/20 3/22	Calculus of Variations Lagrangian Dynamics	Ch. 6 Ch. 7.1 – 7.7	HW #4	3/24
10 3/27 - 3/29	Lagrangian Dynamics	Ch. 7.1 – 7.7		
11 4/3 – 4/5	Hamiltonian Dynamics	Ch. 7.8 – 7.13	HW #5	4/7
12 4/10 4/12	Hamiltonian Dynamics Rigid-body motion	Ch. 7.8 – 7.13 Ch. 11	HW #6	4/14
13 4/17 - 4/19	Rigid-body motion	Ch. 11	Exam #2	4/21
14 4/24 - 4/26	Rigid-body motion	Ch. 11	HW #7	4/28
15 5/1 - 5/3	Relativity	Ch. 14	HW #8	5/5
16 5/8 - 5/14	Final Exam Period		Exam #3	TBD

Grading Policy

The eight homework assignments combined are worth 21% of the total grade. Students may discuss the homework problems with each other, but each student is responsible for preparing their own solutions.

Each of the three exams are worth 23% of the total grade, for a total of 69%. Students may not discuss the exams with each other or external sources.

Participation grade will count as 10% of the total grade. Participation will be determined by pop quizzes throughout the semester at the beginning of class. Each quiz will be three multiple-choice questions based on the reading assignments, and students will have five minutes to complete the quiz.

Course Policies

Questions in class and attendance at office hours are strongly encouraged!!!

Laptops are permitted in class provided they are not a distraction.

Calculators are allowed in the exams, and students can prepare a single two-sided sheet of notes that will be collected with the exam. Any student caught cheating will be reported to the Office of Community Standards and Conduct (OCSC).

Make-up exams will only be given under extraordinary circumstances at the discretion of the instructor and must be requested **before** the scheduled exam.

There are no extra-credit assignments.

Students turning homework in late will lose 15% of the credit each day and receive no credit after 7 days.

Class Materials

The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course, however, these materials are for registered students' use only. Classroom materials may not be reproduced or shared with those not in class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Attendance

The University's attendance policy requirement is that individual faculty set their course attendance requirements. Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. In some courses, instructors may have special attendance requirements; these should be made known to students during the first week of classes.

Class Participation

Regular class participation is expected regardless of course modality. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures (and/or labs). Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Recordings

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

NOTE: if the instructor records any part of the course, then the instructor will need to add the following syllabus statement:

The instructor may record meetings of this course. These recordings will be made available to all students registered for this class if the intent is to supplement the classroom experience. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law.

Comet Creed

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

“As a Comet, I pledge honesty, integrity, and service in all that I do.”

Academic Support Resources

The information contained in the following link lists the University’s academic support resources for all students.

Please see http://go.utdallas.edu/academic-support-resources.

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University’s policies and procedures segment of the course syllabus. Please review the catalog sections regarding the credit/no credit or pass/fail grading option and withdrawal from class.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.