SYLLABUS
PHY 3221, Classical Mechanics I, Spring Term 2022

Instructor: Sergey Klimenko, Klimenko@phys.ufl.edu, 352-514-8225
Meeting time: Monday, Wednesday, Friday, period 6, 12:50-1:40 am
Classroom: Physics Building, 1101
Office Hours: Zoom (in-person meetings by request), Tuesdays 4-5pm and Friday 2-3pm

The course grader: Tan, Lintao, e-mail ltan@ufl.edu, room 2038, Office hours: TBD

Synopsis: This course is the first part of a two-semester sequence (PHY 3221-4222) in undergraduate level classical mechanics. The goal of the first semester is to develop a bridge from the introductory course (PHY2048) to the Lagrange and Hamilton formulation of mechanics to be studied in depth in the second semester of the course (PHY4222). Physics 3221 will cover chapters 1-7 of the textbook by John R. Taylor. Topics include matrices, vector calculus, reference frames, Newtonian mechanics, conservation laws, harmonic oscillator, and calculus of variations.

Prerequisites: Introductory physics with calculus PHY 2048 or equivalent. Fluency in algebra, trigonometry and calculus is necessary for your success in Mechanics I. Calculus III will be used extensively throughout the course. A course in differential equations is recommended.

Course Description: This course lays out the foundation for students to understand the mathematical formulation of Newton's mechanics. Starting with the basic concepts introduced by Galileo and Newton, the course gives a deeper understanding of these concepts and introduces a more advanced formulation of mechanics developed by Lagrange and Hamilton. The Lagrangian and Hamiltonian mechanics gives deeper insights of conservation laws in physics, mechanics of non-inertial frames, motion of complex systems and form the basis of other branches of theoretical physics, including quantum mechanics, statistical physics, and field theory. This course requires more advanced mathematical skills and logical reasoning beyond introductory physics courses. The mathematical framework developed in this course - vectors, vector calculus, differential equations, Fourier series, calculus of variation and linear algebra - provides a solid mathematical background used in science, business, and industry.

Course Learning Goals: The goal of the course is to develop a bridge from the introductory course (PHY2048) to the Lagrangian and Hamiltonian formulation of mechanics. At the end of the semester, students will be able to

- demonstrate a knowledge of Newton's Laws
- demonstrate a knowledge of equations of motion
- understand the conservation laws governing physical systems
- apply advanced Newtonian methods to complex motion problems.
- demonstrate a knowledge of oscillatory motion.

- demonstrate a basic knowledge of Calculus of Variations
- demonstrate a basic knowledge of Lagrangian & Hamiltonian mechanics.
- apply Lagrangian & Hamiltonian methods to complex motion problems.
- develop skills for logical analysis of complex problems
- develop a solid mathematical background used in science, business, and industry

Required textbook: The main text is John R. Taylor, Classical Mechanics. The textbook is necessary - we shall work through most of the end-of-chapter problems in class and on the homework. The UF library has this book on PHY3221 course reserves for the spring term.

References: Classical Dynamics of Particles and Systems by S. T. Thornton and J. B. Marion An Introduction to Mechanics by D. Kleppner and R.J. Kolenkow (These books are on course reserve at the Smathers Library). These books are recommended for additional reading (non-examinable). The UF library has these books on PHY3221 course reserves for the spring term. For additional reading I also recommend a comprehensive book on Mechanics, volume 1 by Landau and Lifshiz. Links to all references are shown here: http://phys.ufl.edu/courses/phy3221/spring22/links.html

PHY 3221 web page is http://www.phys.ufl.edu/courses/phy3221/spring22/ This web page contains information relevant for the class. There you will find the course assignments, exam schedule, the class diary and solutions for the homework and exam problems. Please, check for updates regularly, especially if you miss a lecture.

Quizzes: There will be 9-10 quizzes throughout the semester. The quizzes will not be announced in advance. Each quiz will last no more than 10 min and will be administered at the beginning or end of the lecture. All quizzes will be "closed book" and ***NO*** cell-phones or other hi-tech gadgets are allowed. ***Quizzes will not be accepted outside of the class and overdue quizzes will not be graded***. There will be no make-up quizzes, but one lowest quiz score will be dropped and there will be 3 bonus quizzes. The lowest score is 0 for missed quizzes and 1-4 for taken quizzes. The quizzes will contribute a total of 10% towards the final grade.

Homework: There will be 9 graded homework (HW) assignments during the semester. Working on HW assignments is important to succeed in this course. This practical work will help you to understand the concepts and logical reasoning that lead to a solution. If you are letting others to do this work for you, or just copy solutions from the internet, it may lead to problems at the test time. A good technique for many students is to try all the problems individually, then get together in a group for the tough ones. HW assignments may contain bonus problem. You are not required to work on the bonus problems but solving them may add extra points to your total homework score. Work on simple problems first. Demonstrating that you understand a problem even if you can't solve all its parts will result in a partial credit. However, the partial credit is not applied to the bonus problems. Homework assignments and due dates, subject to change, are available via the Homework link on the left panel of the course web page. Homework will be collected on the Canvas before the due date. Students will need to upload their homework as a single file in pdf format to the corresponding HW assignment in Canvas. ***HWs will not be accepted outside of the Canvas and overdue HWs will not be graded***. Make your solutions neat, concise, and intelligible. It is not sufficient just to state the answer. Points may be deducted if it is difficult to find and/or understand the solutions. T**here will be no make-up homework. Instead, the lowest homework score will be dropped at the end of the semester**. The HW assignments will be worth 30% of the total grade (see the grading policy below).

Exams: There will be three ~100 minutes out-of-class exams scheduled on February 7, March 18 and April 18. There is no final exam for this course. All exams are in person. Make your solutions neat, concise, and intelligible. It is not sufficient just to state the answer. Points may be deducted if it is difficult to find and/or understand the solutions. Work on simple problems first. Demonstrating that you understand a problem even if you can't solve all its parts will result in a partial credit. However, the partial credit is not applied to the bonus problems. **There will be no make-up exams. *Instead, the lowest exam score will be dropped at the end of the semester.*** The remaining two exams will contribute 60% toward the final grade. All three exams will be "closed book" and ***NO*** cell-phones or other hi-tech gadgets are allowed. Calculators are permitted. Relevant Principal Definitions and Equations from the textbook will be provided. During the exam students can also use a single A4 format paper sheet with any hand-written material they prepare before the exam.

Grading procedure: All assignments will be graded within a few days after the due date, exams are graded the next day. The graded assignments will be returned to students and grading scores entered to Canvas for student's review. All questions regarding graded work should be sent to klimenko@phys.ufl.edu or asked in person during the office hours. Each graded assignment (quiz, homework, or exam) has a maximum score (Sm) - the total sum of scores of all examinable problems in the assignment. In addition to the examinable problems, assignments may have bonus questions, which do not contribute to the maximum score, but are accounted for in the total score (S) gained by a student. Because of the bonus questions it is possible that S could be greater than Sm. The ratios S/Sm from all assignments are used to calculate the final percentage score according to the grading formula posted in the Canvas. The percentage score will be determined by your homework assignments (30%), exams (60%) and quizzes (10%). Your final grades will be based on the total sum of percentage scores for quizzes, homework, and exams, and defined by the following grading table:

grade	**A**	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**	**D+**	**D**	**D-**	**E**
score	**90%**	**85%**	**80%**	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**	**41%**	**35%**	**<35%**

The corresponding grades are assigned at or above the score threshold shown in the table. These thresholds may be lowered, depending upon numerous factors, but will not be raised. **C is the lowest passing grade for physics majors!**

For additional details regarding grading policies, please, see the university website:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Requirements for class attendance and make-up exams, assignments and other work in this course are consistent with the university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/

UF students are bound by The Honor Pledge which states "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. The Honor Code can be found here: https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/

Office of Academic Support: offers free one-on-one and small group tutoring sessions to all UF students interested. The tutors are proficient in a broad range of topics, including economics, mathematics, statistics, writing, accounting, Spanish and the physical and biological sciences. OAS tutors go through a rigorous selection process and receive training so that they are prepared to answer questions. Remember these tutoring services are offered at no additional cost to all UF students. Contact information: https://oas.aa.ufl.edu/services/

Student Life Success Services: Enhancing student success through learning and engagement - check out this web page:
https://www.ufl.edu/student-life/success-services/
and contact their academic advisors:
http://www.ufadvising.ufl.edu/college-remote-advising-contacts/

Counseling and Wellness Center: Contact information for the Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/Default.aspx (392-1575), and the UF Police Department: 392-1111 or 911 for emergencies.

Communication and interaction expectations.

Phy3221 is an online synchronous course delivered via Zoom meetings starting on August 31, every Monday, Wednesday and Friday at 12:40-1:30pm, excluding holidays – check out the course schedule Students will need to run zoom on one of suitable devices: computer, tablet or phone with access to the internet. Students will be able to view all lecture material via shared screen and listen to lectures over audio channel. All lectures will be recorded and available from zoom cite or Canvas after classes. Lecture notes will be posted on canvas with links in the course schedule. During lectures students will have the opportunity to ask and answer questions. In addition, twice a week, there will be Zoom Office Hours: Tuesdays 2-3pm and Fridays 4-5pm. All assignments will be posted in Canvas with specified start and end date and time. Quizzes and exams will be proctored by Honorlock. For each assignment students should compile their work in a single pdf file and upload this file to the corresponding Canvas portal. All grade scores will be stored in Canvas.

Technologies that will be used in the course.

Phy3221 synchronous course heavily relies on Canvas and Zoom. Students will need to run a zoom app on one of suitable devices: computer, tablet or phone with access to the internet. Students will be able to view all lecture material via shared screen and listen to lectures over audio channel. All lectures will be recorded and available from zoom cite or Canvas after classes. Quizzes and exams will be proctored by Honorlock. For each assignment students should compile their work in a single pdf file and upload this file to the corresponding Canvas portal. For preparation of graded work it is recommended to use a tablet and graphic pen together with a suitable note taking application (for example Good Notes 5) which allows to save notes in pdf format. Also, students may use a usual pen and white paper to do the course assignments, scan multiple paper sheets into a single pdf file and upload it to Canvas.

Provide learners with information on protecting their data and privacy for tools introduced or recommended throughout the course.

Canvas is used to keep track of all personal data, graded work and grades. Scheduled course zoom meetings are protected by password.

How to find academic or student services support.

how the course materials help students to complete courses activities and achieve the course learning objectives.

how each activity or assignment is related to the course objectives and how submitted work is evaluated.

- Lectures give detail and interactive explanation of the text-book material, explanation of main concepts, their relations to each other, description of real world and step-by-step application of these concepts to solve problems. The goal of lectures is not to memorize material but to develop critical thinking, which is crucial in understanding of main concepts and their applications for solving problems.
- Lecture notes keep track of the discussion topics and put the text-book material in the context of specific problems discussed in class
- Quizzes provide quick assessment of topics missed by students and common mistakes
- Homework is the main tool to master math skills and logical reasoning.

- Exams give students an opportunity to test their knowledge and demonstrate that they can think clearly, rationally and can make logical connections between different ideas to solve problems. Both exams and homework do not use multiple choice problems.

All submitted work is evaluated not just to get a grade, but to help students to understand their mistakes in use and application of basic concepts and logical reasoning. Usually there is no penalty for typos and small mistakes and students get almost full credit if they demonstrate understanding of the problem and provide conceptually correct solutions.

Its methods and ideas are crucially important, as they form the basis of all other branches of theoretical physics, including quantum mechanics, statistical physics, and field theory. Such concepts as the Lagrangian and Hamiltonian formalisms, normal oscillations, adiabatic invariants, Liouville theorem, and canonical transformations lay the foundation, without which any further in-depth study of theoretical physics is impossible.

1. Demonstrate an intermediate knowledge of Newton's Laws. DLO 1 2. Demonstrate a basic knowledge of equations of motion. DLO 1, 2 3. Apply advanced Newtonian methods to complex motion problems. DLO 1, 2 4. Demonstrate an intermediate knowledge of oscillatory motion. DLO 1, 2 5. Describe and model the oscillations of damped and undamped systems. DLO 1, 2 6. Demonstrate a basic knowledge of Calculus of Variations. DLO 1 7. Demonstrate a basic knowledge of Lagrangian & Hamiltonian dynamics. DLO 1 8. Apply Lagrangian & Hamiltonian methods to complex motion problems. DLO 1, 2 9. Demonstrate an intermediate knowledge of central-force motion. DLO 1, 2 10. Apply advanced methods to complex central-force motion problems. DLO 1, 2 11. Generate solutions to mathematical problems using current data analysis software (Mathcad). DLO 2, 4 12. Apply the fundamental processes of investigation, modeling and analysis DLO 2, 3

This is an upper level college physics course that emphasizes a systematic approach to the mathematical formulation of mechanics problems and to the physical interpretation of the solutions. Fundamental concepts and principles in classical mechanics will be applied to particles, systems of articles and rigid bodies. The mathematical framework developed in this course will consist of advanced mathematical and numerical techniques that will provide a solid mathematical background used in all modern physics.

Mechanics 1

Sergey Klimenko

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course web page

Welcome to Mechanics 1 - the first course of the two-semester sequence in undergraduate level classical mechanics. This is an online synchronous course delivered via Zoom meetings starting on August 31, every Monday, Wednesday and Friday at 12:40-1:30pm. Check out the Course Description below, and particularly the **main course web page** -- the collections of useful links you will use during the semester. The course page also lists the required books and technologies; you'll need these beginning August 31st. The course policies are described in **syllabus**, including description of the course assignments and grading policy. You could keep track of classes in the **course schedule** -- it lists all course assignments, important due dates and has links to the course notes. While the exam dates and the assignment due dates are unlikely to change, please, note that the **course schedule** is a living document, which is updated to accommodate for possible schedule changes during the semester. All sensitive information (graded work, grade scores, etc) will be stored in Canvas, which will also be used for online exams and quizzes with the Honorlock proctoring. Links to all scheduled zoom meetings will be available via Canvas Calendar.

Course Description: This course lays out the foundation for students to understand the mathematical formulation of Newton's mechanics. Starting with the basic concepts introduced by Galileo and Newton, the course gives a deeper understanding of these concepts and introduces a more advanced formulation of mechanics developed by Lagrange and Hamilton. The Lagrangian and Hamiltonian mechanics gives deeper insights of conservation laws in physics, mechanics of non-inertial frames, motion of complex systems and form the basis of other branches of theoretical physics, including quantum mechanics, statistical physics, and field theory. This course requires more advanced mathematical skills and logical reasoning going beyond introductory physics courses. The mathematical framework developed in this course - vectors, vector calculus, differential equations, Fourier series, calculus of variation and linear algebra - provide a solid mathematical background used in other branches of science

Course Prerequisites: Introductory physics with calculus PHY 2048 or equivalent. Fluency in algebra, trigonometry and calculus is necessary for your success in Mechanics I. Calculus III will be used extensively throughout the course. Courses in differential equations and linear algebra are recommended.

Course Learning Goals: The goal of the course is to develop a bridge from the introductory course (PHY2048) to the Lagrangian and Hamiltonian formulation of mechanics. At the end of the semester, students will be able to

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- apply Lagrangian & Hamiltonian methods to complex motion problems.
- develop skills for logical analysis of complex problems
- develop a solid mathematical background used in other branches of science