

PHY 4222 Mechanics 2
Spring 2022 syllabus

Instructor:	Yasu Takano, NPB 2356, phone 352-392-9326 (email: takano AT phys dot ufl dot edu)
Class meetings:	M W F period 6 (12:50 PM – 1:45 PM), NPB room 1002, synchronously broadcasted via Zoom
Textbook:	John R. Taylor, Classical Mechanics (University Science Books, 2005)
Prerequisites:	PHY 2048 (Physics 1 with calculus) or equivalent, and PHY 3221 (Mechanics 1) or equivalent such as PHZ 3113 taught by Professor Wang
Office hours:	Read the section entitled Tutorials and the one entitled Office Hour

Synopsis

The second part of the two-semester classical mechanics sequence, this course covers two-body central-force problems (think of the orbits of planets and comets around the Sun), mechanics in nonlinear frames (where fictitious forces such as the centrifugal force and the Coriolis force are useful), rotational motion of rigid bodies, coupled oscillators and normal modes, nonlinear mechanics and chaos, the Hamiltonian mechanics, and continuum mechanics. These are subjects of Chapters 8 – 13 and 16 of Taylor. Not covered are Chapters 14 and 15 of the book, on the collision theory and the special relativity—on the latter Griffiths' Introduction to Electrodynamics, used in PHY 3323 and PHY 4324, does a better job. The mathematics required for this course is mostly ordinary differential equations and linear algebra.

Class expectations specific to Spring 2022

In response to COVID-19, the following practices are in place to maintain your learning environment, to enhance the safety of our in-classroom interactions, and to further the health and safety of ourselves, our neighbors, and our loved ones. The situation in Florida is so grave, but the UF cannot mandate vaccination and wearing of approved face coverings because of political constraints imposed by Tallahassee. So please, please be responsible and do your part.

- * If you are not vaccinated, get vaccinated. Vaccines are readily available at no cost and have been demonstrated to be safe and effective against the COVID-19 virus. Visit this link for details on where to get your shot, including options that do not require an appointment: coronavirus.uflhealth.org. Students who have receive the first dose of the vaccine somewhere off-campus and/or outside of Gainesville can still receive their second dose on campus.
- * You are expected to wear approved face coverings at all times during class and within buildings. UF Health recommends K95 or NK95, not surgical masks or cloth masks. Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.
- * Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.
- * Hand sanitizing stations are located in every classroom.
- * If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF

Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus. UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.

* If you are withheld from campus by the Department of Health through Screen, Test & Protect you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.

* Continue to regularly visit coronavirus.UFHealth.org and coronavirus.ufl.edu for up-to-date information about COVID-19 and vaccination.

* All lectures in this course are given in the HyFlex format. This allows you to attend lectures remotely and synchronously via Zoom, if you do not want to, or cannot, attend them F2F for any reason.

* Lecture notes and Zoom videos of the lectures will be accessible via Canvas.

Your aims in this course

By completing this course, students will gain deeper understanding of some of the general principles in physics—symmetries and conservation laws—and become familiar with basic concepts in some advanced subjects such as chaos and continuum mechanics. To achieve this this, it is essential that you do all Examples in the book, and all recommended problems and homework problems—more on this under **How to Study**.

Lectures

As you must have learned by now, lectures in upper-level physics are not meant to spoon-feed recipes for solving problems, nor are the exams in those courses meant for you to apply those recipes. Lectures are intended to help you develop critical thinking, learn the habit of using math as a tool to develop conceptual understanding, and learn by doing problems yourself. In this course, most of recommended problems from the book cannot be solved by simply applying memorized recipes.

For these reasons, lectures will assume that you have read the corresponding part of the textbook.

All lectures in this course are given in the HyFlex format. This allows students to attend lectures remotely and synchronously via Zoom, if they would like to—or have to—stay away from the classroom for any reason. To facilitate this, lectures are delivered primarily by writing on PowerPoint slides as a substitute for a chalk board. All lectures are recorded in Zoom and made available on UFCloud via a link in Canvas. The recordings will be accessible only to those who are registered for this course and will be deleted after Exam 3.

Lecture notes

In lieu of lecture notes, PowerPoint slides from Spring 2021 are posted in Canvas as a pdf file for each chapter except Chapter 16 (Continuum mechanics). PowerPoint slides used this semester will be posted in Canvas immediately after each lecture.

Office hours

There are normally three office hours per week: Monday and Thursday period 7 (1:55 PM – 2:50 PM), and Friday period 8 (3:00 PM – 3:50 PM). The office hour on Monday is in the HyFlex format so that a social distance can be maintained as recommended by the CDC. In Zoom, waiting rooms will be used to allow for privacy. The office hours on Thursday and Friday are used for tutorials and are via Zoom only. (Read the next section about **Tutorials**.)

Tutorials

In the HyFlex format, lectures will have to be delivered at a slower pace, leaving little room to do long problems. This deficiency will be remedied by providing weekly tutorials, akin to discussions in introductory physics. They

are optional, not required. A typical tutorial will discuss two end-of-chapter problems from the list of recommended problems. The problems, listed on the Course Schedule page on Canvas, are the same for Thursday and Friday. You may attend the one that is more convenient for you. There will be no tutorials for Chapter 12, because most good problems in that chapter must be solved numerically with a computer.

Zoom

Zoom for lectures starts with your microphone muted. When you ask a question or give a comment, temporarily un-mute yourself by pressing the space bar on the keyboard of your computer. Releasing the space bar will automatically mute your mic. Zoom for office hours and tutorials starts with your mic on. For office hours, the waiting-room feature of Zoom is used to allow for privacy.

Lectures are recorded. The recordings are made accessible only on UFCloud via a link in Canvas and only to students who are registered for this course. They will be deleted after Exam 3. All parts that are recorded before a lecture starts at 12:50 PM and after it ends at 1:45 PM are edited out before posting. Office hours and tutorials are not recorded.

Zoom will not record what your camera shows, your name, or your profile image. But your voice will be recorded. If you do not like your voice recorded during class, you are allowed to communicate via Zoom's chat, which is not recorded or shared. If you do use chat, please immediately alert the instructor orally because it is difficult for him to keep an eye on the chat indicator during a lecture.

Unauthorized recording and unauthorized sharing of recorded materials is prohibited.

How to Study

As you already know, physics cannot be studied without doing problems. The primary purpose of doing problems is to acquire conceptual understanding of the subject and to develop intuition on the behavior of physical systems. There are a right way and wrong way of doing problems. The right way comprises five components: (1) to expect the result before embarking on calculation, (2) to keep track of information content as you manipulate equations, (3) to examine the result for correct dimensions and symmetry, and to check whether it agrees with simple/obvious/known results for special cases (e.g. the limit in which one of the independent variables becomes infinite or zero), and (5) to compare the result with what you have expected and, if your expectation has turned out to be wrong, to correct the wrong intuition that has led to the wrong expectation. Of these, 1 and 5 are the keys to developing intuition. What is the wrong way of doing problems? It is what I call "black-box shaking"—putting equations in a figurative black box and shaking it until a solution pops out.

You are expected to do all Examples in the book and all recommended problems, a list of which will be provided for each chapter, usually attached to the end of a homework-assignment pdf file. Homework problems are intended to supplement recommended problems, not to replace them. They, as well as exams, will assume that you have done recommended problems. Without doing recommended problems, you will not do well in the exams.

When doing problems, it is critically important that you first make a genuine effort to solve them by yourself. When stuck, discuss with other students, seek help from the instructor, or consult the Student Solution Manual.

Student Solution Manual

A solution manual for all odd-numbered problems in the book is available directly from the publisher, <https://www.uscibooks.com/>, for \$34 in softcover and \$25 eBook. The manual is not for students who may be tempted to look at solutions without attempting to do the problems themselves. But for those who put in a genuine effort and then get stuck, the manual can be useful.

Homework

There will be roughly one homework assignments every week, each containing about 4 problems, most of them from the book. Of those, 1 randomly chosen problem will be graded, although solutions to all assigned problems will be posted on Canvas. All homework assignments weigh the same.

Collaboration with other students are strongly encouraged (read the section about **Zoom** above for how to set up Zoom meetings with your classmates), but the work you turn in must not be a copy of solutions by others. If the work shows a sign of copying a solution, be it from another student or internet, a zero will be given for the entire assignment. Homework must be written neatly, with words and sentences provided to make your solutions understandable and the final results clearly marked as such. Points will be deducted if your solutions are hard to read or hard to understand. Points will also be taken away if your homework shows a sign of “black-box shaking”—such as circular arguments and undirected manipulation of equations—or your result lacks required symmetry or is dimensionally incorrect. There will be no penalties for errors arising from typos that cannot be detected by symmetry and dimension checks.

Homework must be uploaded as a single pdf file to Canvas by 11:30 AM of the due date. No other way of submitting homework is allowed. To create a pdf file from handwritten sheets, some students use CamScanner, but there are also alternatives to this app, some of them free: <https://seawallalife.com/camscanner-alternatives/>. You may also use a real scanner or take a picture of each handwritten sheet. An instruction on how to combine multiple pdf files to a single one can be found in Canvas, under Files > ConvertingCellPhonePics2pdf.pdf.

No late work is accepted, since solutions to the assigned problems will be posted in Canvas on the due date, immediately after 11:30 AM. No make-up assignment will be given for a missed homework. Graded homework will be returned via Canvas usually within one week after the due date.

Exams

There will be 3 two-hour exams. The date and time of Exam 3 have been set by the Registrar, as they appear in the Course Schedule. The dates and times of Exams 1 and 2 are tentative and subject to change. For an exam missed for an excusable reason with a verifiable supporting document, a makeup exam will be provided, but only if the student contacts the instructor before the exam or—in case of unexpected emergency—within one week after the exam.

Each exam will have three problems, each with a few parts. They will be closed book, closed note. If necessary, a formula sheet will be posted in Canvas before each exam and provided in the exam. You will not be allowed to use your own formula sheets, nor a calculator (there will be no numerical questions). Exam 1 will cover Chapters 1 and 2 of Callen, Exam 2 Chapters 3 through 5, and Exam 3 Chapters 6 through 9 and 11.

You will do well in exams only if you do all Examples, recommended problems, and homework problems. Turning in homework by copying solutions without understanding why, not just how, will not lead to a good grade.

Grading

Grades will be based 75% on exams and 25% on homework. Each of the 3 exams is worth 27% of the grade. All homework assignments weigh the same, although the number of problems may vary slightly from assignment to assignment. Two lowest homework scores will be dropped, whereas there will be no drop for exam scores.

The lower threshold of each letter grade will be as follows.

- A 85%
- A- 80%
- B+ 75%
- B 70%
- B- 65%
- C+ 60%
- C 55%
- C- 50%

D+ 45%
D 40%
D- 35%
E less than 35%

For most science and engineering majors, the lowest passing grade is C.

Announcements

All announcements are made in Canvas, which will automatically send you an email. Three most recent announcements will appear also on the course homepage in Canvas, and all announcements will be archived in Canvas, under Announcements.

How to contact the Instructor

To contact the instructor, always send an email to takano at phys dot ufl dot edu from your GatorNet account, with the word “PHY3513” included in the subject line. Please do not contact him via Canvas. He will ignore all messages sent from Canvas because his very secure email client—he does not use Outlook—will not allow him to directly respond to messages and questions sent from Canvas. He will also ignore emails that are sent from non-GatorNet accounts. Gmail users beware.

Inclusion and diversity

Physics is practiced and advanced by a scientific community of individuals with diverse backgrounds and identities and is open and welcoming to everyone. The instructor recognizes the value in diversity, equity and inclusion in all aspects of this course. This includes—but is not limited to—differences in race, ethnicity, gender identity, gender expression, sexual orientation, age, socioeconomic status, religion and disability. Students may have opportunities to work together in this course. We expect respectful student collaborations such as attentive listening and responding to the contributions of all teammates.

Physics, like all human endeavors, is something that is learned. It is the aim of the instructor to foster an atmosphere of learning that is based on inclusion, transparency and respect for all participants. He acknowledges the different needs and perspectives we bring to our common learning space and strive to provide everyone with equal access. All students meeting the course prerequisites belong here and are well positioned for success.

In-class recording by students

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party

note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Additional Information

Requirements for lecture attendance, exams, assignments, and other work in this course are consistent with 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, <https://disability.ufl.edu>) by providing appropriate documentation. Once registered, students will receive an Accommodation Letter, from the Center, which must be forwarded to the instructor within the first two weeks of the semester.

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://gatorevals.aa.ufl.edu/students/>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments 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." On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. You are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor.

Campus Resources

Canvas technical support: <http://helpdesk.ufl.edu/>, 352-392-4357, helpdesk@ufl.edu.

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit <https://umatter.ufl.edu> to refer or report a concern and a team member will reach out to the student.

Counseling and Wellness Center: <https://www.counseling.ufl.edu>, 352-392-1575.

Student Health Care Center: <https://shcc.ufl.edu>, 352-392-1161 (a 24/7 number).

University Police Department: <https://police.ufl.edu/>, 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: <https://ufhealth.org/emergency-room-trauma-center>. For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608.

Student Complaints On-Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/student-complaint-process/>.

Career Connections Center: <https://career.ufl.edu>. Reitz Union Suite 1300, 352-392-1601.