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Instructor

Dr. Hanno Rein
My preferred pronouns are he/him/his. Hanno is my first name. Rein is my last name. If you are an undergraduate student, you should not address me by first name. When sending me an e-mail, please use an appropriate opening line such as "Dear Professor Rein". I like cats. Please send me pictures of your cat.

Office hours

There will be regular online office hours during which I will be available to meet with you individually or as a group. You can always e-mail me to setup extra office hours. Please include a few times that would work for you in the e-mail.

E-mail

hanno.rein@utoronto.ca
I try to respond quickly to e-mails Monday to Friday, 9am to 5pm, but I am unlikely to respond outside of these hours. Please send your e-mail from your university account and include your student number.

TA

Pejvak Javaheri
pejvak.javaheri@mail.utoronto.ca

Text Book

The lectures will closely follow the textbook Classical Mechanics by John R. Taylor. I encourage you to either get a physical or electronic copy of the book. Alternatively, the UTSC library has also copies available.

Learning outcomes

At the end of this course, you will be able to construct idealized dynamical models and predict model response to applied forces using Newtonian mechanics. Specific learning objectives are:

- Understand the basic principles of 2D rigid body motion
- Understand central force motion
- Formulate the equations of motion of 2D and 3D rigid bodies
- Understand linear theory of harmonic oscillators
- Understand basic concepts of Chaos and Chaotic systems

Measurable outcomes are

- Provide a definition for basic concepts such as force and mass in Newtonian mechanics
- Select and use an appropriate coordinate system to describe particle motion
- Describe particle motion using intermediate reference frames, which can be in relative motion (including rotation) with respect to each other
- Identify and exploit situations in which integrated forms of the equations of motion, yielding conservation of momentum and/or energy, can be used
- Use the Lagrange equation to solve the motion of constrained systems
- Utilize 2-body orbital mechanics to analyze spacecraft trajectories
- Model and analyze simple problems involving vibration with and without damping
- Explore, model and analyze simple problems involving Chaotic system
- Solve differential equation on a computer
- Visualize trajectories on a computer
- Integrate the equations of motion for a planetary system on a computer

Lectures

The lectures will be start online synchronous for the first few weeks. The course normally includes several practical components (rocket launch), so I very much hope that we will be able to meet safely in person at some point again. The university is currently planning to switch all lectures to in-person by February (but I have some doubts that this is realistic).

Both online and in-person lectures will be on Thursdays 1:10pm - 3:00pm. The lectures will not be recorded. I will try to make the lectures as interactive as possible, we sometimes will use a flipped classroom, there is a participation mark, and there might be quizzes during the lectures. For all those reasons, you will need to attend the lectures synchronously.

The lectures will start 10 minutes past the hour. Please be on time. If you are registered with Accessibility Services and need to use an electronic device during lectures, please contact me before the start of the term to find an acceptable arrangement. Note that although this lecture will take place around lunchtime, eating lunch during the lecture is not acceptable. You will be asked to leave the lecture if you do not follow these rules.

Covid safety

Because COVID19 is an airborne virus, you are required to wear a mask in the classroom at all times. You cannot remove your mask at any time while inside the lecture room. I will provide you with a free high quality N95 mask when we first meet in person. I strongly encourage you to wear this or a comparable N95 mask. Cloth masks, including the one provided by UofT are not effective at filtering out the small virus.

Disabled. Not visible to students

If possible, we will keep the windows open during the lectures. Please dress accordingly. I will also bring a CO_2 meter to class. If the CO_2 levels reach 800ppm or above, we will end the lecture immediately. In that case, I will record the remainder of the lecture and post a video online.

If a student removes their mask at any time, I will end the lecture immediately. The material of the lecture will still be on the exam. You will need to read up on the material yourself. I will not provide a video of the lecture.

Tutorials

The tutorials will be start online synchronous for the first few weeks. Afterwards, the tutorials will be in-person unless the university changes its health and safety guidelines.
Thursdays, 5:10pm - 6pm
Attendance is mandatory for all tutorials. During the tutorials, you will apply the knowledge from the previous lecture. This might involve you working on an assignments. Myself and the TA will guide and assist you through the tasks. Note that you might either need to hand in your assignment by the end of the tutorial, or by the end of the week. We might work on computational problems during the tutorials which require access to a computer. While we're online, this is straightforward. If we meet in-person, you should bring a laptop to the tutorial. If you don't have one, please get in touch and we'll figure something out.

Zoom Link (for online lectures, tutorials, and office hours)

https://utoronto.zoom.us/j/82502399983

Technical requirements

To successfully complete the course, you will need to run code using python, jupyter notebooks, numpy, scipy, and matplotlib. We will use python 3 in this course (python 2 is not acceptable). You can either install all software on your own computer, or use a cloud based service such as https://utoronto.syzygy.ca . Both of these options have their advantages and disadvantages. Both are free for you to use.

Journal

I will ask you to write regular journal entries for this course. In the past, these have been physical journals. This year, I will allow electronic submission and you do not need to buy a bound journal.

Grading Scheme

Attendance / Participation 10%
Assignments / Quizzes / Journal entries 40%
Mid-term self-evaluation 5%
Final self-evaluation 5%
Final exam (oral) 40%

Note that there is no formal midterm. You will give yourself the grade you think you deserve for the self-evaluation parts. The final exam will be an oral exam.

Academic Integrity in PHYB54

In addition to general rules about academic integrity listed below, there are several ones that apply specifically to PHYB54.

- Most importantly, you are explicitly given permission to use to internet to help you with assignments, quizzes, and even exams. However, keep in mind that the questions have been designed with the internet in mind. A simple google search is unlikely to provide you with the correct answer. You will have to think for yourself. Also note that for many questions, it will be much faster to recall basic knowledge from memory rather than googling it. Time will be limited and you will most likely be under pressure to answers as many questions as possible. Use your time wisely.
- Whereas you are encouraged to interact with other students in the course, you cannot use their work and hand it in as yours. If you work together with another student, each of you will need to indicate this when you submit your assignments. Failure to do so will count as an academic offence. Note that even if you work together, each of you needs to work on their own document. Do not submit the same document. Here is a simple question you should ask yourself when submitting an assignment: Do I fully understand what I am about to submit? If the answer is no, then you might be about to commit an academic offence.
- Do not ask friends or relatives to do the assignments for you. Do not hiring someone to do the assignment for you. This would be a serious academic offence.
- As a general rule, you can use the internet to access information, but you cannot post any lecture material online. This includes lecture materials, assignments, quizzes, and exams. You cannot post such material on public spaces (such as forums, stackoverflow, etc). You also cannot share them in private spaces (chats, instant messages, etc). Documents might be watermarked with your student ID and might be traced back to you.
- You need to write the journal yourself. You cannot copy material from another student.

There are other offences covered under the Code of Behaviour on Academic Matters as described below. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behaviour on Academic Matters.

Academic integrity (general)

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently. Detailed information about how to act with academic integrity, the Code of Behaviour on Academic Matters, and the processes by which allegations of academic misconduct are resolved can be found online: http://www.artsci.utoronto.ca/osai/students .

According to Section B of the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm) which all students are expected to know and respect, it is an offence for students to:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- To include false, misleading or concocted citations in their work.
- To obtain unauthorized assistance on any assignment.
- To provide unauthorized assistance to another student. This includes showing another student completed work.
- To submit their own work for credit in more than one course without the permission of the instructor.
- To falsify or alter any documentation required by the University. This includes, but is not limited to doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

Missed tutorials and exams

If you miss a tutorial, a deadline for an assignment, a quiz for a valid reason, your final exam will be worth more. However, if you miss a tutorial, a quiz, or the mid-term for a non-valid reason, these components of your grade will be counted as zero points. Deadlines in this course are hard deadlines. You cannot hand in a late assignment. You have to participate in the final oral exam in order to pass this course.
What counts as a valid reason to and what not is hard to define precisely in these unusual times. Try to submit official supporting documentation to support your case whenever possible. Note that a late enrolment in the course does not count as a valid reason for missing the first assignments and quizzes.

Accessibility

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office. The earlier you do that, the better I will be able to accommodate you. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. They can be reached via telephone and e-mail: 416-287-7560, ability@utsc.utoronto.ca.

Tentative Schedule:

Note that this is only a tentative schedule of the material that we will cover in each lecture. It might change.

Week 1, January 13th
Introduction to course and overview of topics
Newton's Laws of motion (Chapter 1)

Week 2, January 20th
Projectiles and Charged Particles (Chapter 2)
Getting started with python, jupyter notebooks, matplotlib

Week 3, January 27th
Momentum and Angular Momentum (Chapter 3)

Week 4, February 3rd
Energy (Chapter 4)
Differential equation solvers

Week 5, February 10th
Oscillations (Chapter 5)
Using the scipy ODE solver

Week 6, February 17th
Oscillations (Chapter 5)
Assignment 1 discussion

Reading Week - No lecture or tutorial on February 24th

Week 7, March 3rd
Lagrange Equation (Chapter 7)

Week 8, March 10th
Central Force Problems (Chapter 8)
Assignment 2 discussion

Week 9, March 17th
Coupled Oscillators (Chapter 11)

Week 10, March 24th
Geometric integration methods Chaos (Chapter 12)

Week 11, March 31st
Orbital mechanics with REBOUND Chaos (Chapter 12)

Week 12, April 7th
TBD

Course Status

Unpublished
Publish

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