PHYC54-2020: Classical Mechanics

Course Instructor:
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Course Meeting Times
Lectures: 2 hours / week & Tutorial: 1 hour / week (Tuesday: 12:00 AM – 13:00 AM)
Office hours: Monday 12.00-13.00 and Wednesday 12.00-13.00.

Course Description:

A course that will concentrate on the study of symmetry and conservation laws, stability and instability, generalized coordinates, Lagrange equations, Hamilton’s principle, Hamilton’s equations, phase space, Liouville’s theorem, canonical transformations, Poisson brackets & Noether’s theorem. Non-inertial reference frames & rigid body motion.

Textbook and References:


References:

Classical Dynamics of Particles and Systems, by Stephen T. Thornton and Jerry B. Marion.
Classical Mechanics, 3d edition by Herbert Goldstein, Charles Poole, John Safko (Addison Wesley). This is standard textbook for many graduate courses.

Course overview & Objectives:

This is the upper division in Classical Mechanics course primarily intended for Physics/Astrophysics & other DEPS students. PHYC54 continues to study the subject of Classical Mechanics which is the study of macroscopic mechanical systems at low speeds obeying principles of Newtonian Mechanics. Once again, the subject will be considered from different perspectives of traditional Newtonian, Lagrangian and Hamiltonian methods. However, the second part of the course places more emphasis on practical applications of these general principles towards specific problems of complicated oscillatory systems, the motion of rigid bodies, and mechanics of continuous medium.

One of the main objectives of this course remains to demonstrate natural connections between these approaches as well as the advantages of particular approach towards solution of specific problems. Classical Mechanics is a mature subject which lies at the core of Physics. Your familiarity with mathematical
techniques such as vector calculus, differential equations, and linear algebra will allow us to pursue a rather sophisticated study of Mechanics, and by applying these powerful tools to physical problems, you will sharpen both your physical intuition as well as your mathematical skills.

The objective of the student is to develop the skills necessary to analyze the behavior of the aforementioned mechanical systems based on variety of mathematical methods of Classical Mechanics. The skills developed in this class may serve as a passage towards consideration of more complex problems of quantum mechanics and quantum field theory.

**Academic Expectations & Collaboration:**

Lectures will be delivered online; they will be recorded & posted on Quercus. You are encouraged to attend tutorials as problem will be solved by students, which is very important to better understand the material covered.

Adhering to high standards of academic integrity is an important part of your undergraduate experience. The standards are obvious when it comes to exams. Collaboration, such as working with others to conceptualize a problem, define approaches to the solution, or debug code, is often a gray area, and faculty in different courses may have different approaches to this issue.

In this course, discussion is allowed as long as it is identified. Plagiarism, such as copying someone else’s solution or from other sources, such as Internet, is not allowed. The write-ups must always be your own. Modifying someone else’s Assignment to make it your “own” is unacceptable. In case of doubt, consult the course instructor.

If you choose to collaborate with other students on the homework problems, indicate their names and the nature of your joint work. Ensure that your collaborator does the same on his/her assignment. A useful discussion of these issues may be found at [http://ctl.utsc.utoronto.ca/home/integrity](http://ctl.utsc.utoronto.ca/home/integrity).

**E-Mail:** I will only respond to e-mails sent from a recognized University of Toronto address. Please put PHYC50 in the subject line of any course-related e-mails. Will try to respond within 24 hours during Monday to Friday. We **will not accept solutions to Assignments via e-mail only for special cases.**

**Assignments, Tutorial, Tests & Exam**

- There will be two midterm Tests to be held according to the Registrar’s schedule.
- There will be 5 to 6 problem during the semester with 4 to 5 problems in each Assignment.
- You will work on problems during the tutorials every week.
- During the last two weeks (exam period, as set by Registrar’s office) there will be a comprehensive final exam, which covers all the material.
Assignments Policy & Submission Checklist

1. Problem set Assignments & Tutorials work will be submitted by student online on Quercus within the due date posted. There will be a penalty of 50% after the first 15 minutes and a zero will be rewarded after that.
2. The Instructor reserve the right to send the assignment paper(s) to TURNITIN service in case there is significant overlap with publisher notes or solutions.
3. HomeWorks are assigned at least a week before due date. Therefore, to be fair with other students no excuses (including doctor notes) will be accepted for extension or not submitting the homework.
4. Each homework problem must be on a separate sheet of paper. If you need more than one sheet you should staple them together.
5. You need to attempt all questions on the assignment though only 2 or 3 questions only will be graded from each problem set, missing any problem mean 20% deduction will be applied.
6. When collaborating, please be sure to write the name(s) of those you discuss with on the top of your homework.

Note that collaboration is not sharing code files or copying someone’s answers or a program code. It is discussing concepts and asking questions to help clarify your own difficulties with the problem set.

For all graded problems, in addition to any mathematical work, We expect clear written statements at each stage in the solution. Full marks will not be awarded without this. Another problem that sometimes arises is that of legibility. It takes a lot of time to grade problems for the marker. You will likely be more successful on your problem sets if you do what you can to not frustrate the marker. Please put some effort into ensuring that your work is clearly written.

In case some problem sets require the use of computers. Programming with Python, Mathematica (or MATLAB) is not an end in itself but a means to investigate more complex phenomena using visual, analytic and numerical methods. The code itself is not an adequate solution to the problem; you must interpret your results and answer the questions posed. You should approach the problem with the goal to understand and explain the physical phenomena investigated and the behavior of the system for variations of the parameters.

**Grading:**

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<tr>
<th>ACTIVITIES</th>
<th>PERCENTAGES</th>
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<tbody>
<tr>
<td>Problem sets</td>
<td>22%</td>
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<tr>
<td>Two Midterm tests</td>
<td>24% (Test-1: 12% &amp; Test-2: 12%)</td>
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<tr>
<td>Final exam</td>
<td>46%</td>
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Calendar:
The tentative calendar below provides information about the Topics covered in this course. This schedule follows the textbook by John R. Taylor. However, you may use other books that cover the same topics.

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<tr>
<th>CHAPTER #</th>
<th>TOPICS</th>
<th>Week</th>
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<tbody>
<tr>
<td>Chapter-1-5</td>
<td>Review of Newtonian Mechanics</td>
<td>Week-1</td>
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<td>Chapter-6</td>
<td>Calculus of Variations</td>
<td>Week-2</td>
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<td>Chapter-7</td>
<td>Lagrange’s Equations</td>
<td>Week-3</td>
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<td>Chapter-13</td>
<td>Hamiltonian Mechanics</td>
<td>Week-4 &amp; 5</td>
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<td>Chapter-9</td>
<td>Mechanics in Non-inertial Frames</td>
<td>Week-6</td>
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<td>Chapter-10</td>
<td>Rotational Motion of Rigid Bodies</td>
<td>Week-6 &amp; 7</td>
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<td>Chapter-11</td>
<td>Coupled Oscillators and Normal Modes</td>
<td>Week-8</td>
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<td>Chapter-16</td>
<td>Continuum Mechanics</td>
<td>Week-9 &amp; 10</td>
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<td>Chapter-15</td>
<td>Relativistic Mechanics (Time permit!)</td>
<td>Week-11</td>
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If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the AccessAbility Services at UTSC (ability@utsc.utoronto.ca) as early as possible in the term. They will determine reasonable accommodations for this course.

GOOD LUCK