Course Website: https://brahms.phys.westminster.edu/mech

Instructor:
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knopra@westminster.edu
Office Hours: MWF 1-2PM, or by arrangement


Required Software
Every student will need to have access to two pieces of software. You will probably want to have this installed on your own laptop, but you can also find these installed on the various physics computers, both under Linux and Windows.

• A computer algebra system such as Maxima or Mathematica. The instructor uses Maxima, and is not at all familiar with Mathematica, so unless you are yourself already more adroit with Mathematica, you should download and install Maxima. You will also want wxMaxima, which is the GUI front end. If you don’t know where to find these for your OS, try this web page:
  – http://andrejv.github.io/wxmaxima/download.html

• Python with SciPy and Matplotlib. Python 3 is what we used in Computational Physics, and what I recommend you install. On Windows and MacOX, if you install Anaconda, you will get a distribution of Python that already includes SciPy and Matplotlib. (If you’re on Linux, just use your package manager to get those things.)
  – https://www.anaconda.com/download/ (try this one before messing with the others!)
  – https://www.python.org/downloads/
  – http://www.scipy.org/
  – https://matplotlib.org/downloads.html

Course Overview
The actual physics of this course is the same as the physics you learned in Physics 151. We’ll be dealing with systems that operate under Newton’s Laws. However, we’re going to take a higher-level and more sophisticated approach, and we will learn how to analyze systems that would have been prohibitively difficult using the methods you already know. We will be making extensive use of differential equations in this course, and will be using both analytic and computational methods to solve those equations to calculate the motion of a system.

These are the topics we will cover:
• A review of Newton's Laws, momentum and angular moment, and energy.
• Oscillators: SHO, driven, damped, resonance, coupled oscillators.
• A brief introduction to the Calculus of Variations
• Lagrangian mechanics
• Accelerated (including rotating) reference frames
• Rotational motion of rigid bodies (including the moment of inertia tensor)
• Nonlinear mechanics and chaos

Course Outcomes
At the end of the semester, the successful Physics 351 student will be able to:

• Understand Newton’s Laws and classical conservation laws at a deeper level than they obtained from Phys. 151;
• Analyze classical oscillators, including coupled oscillators and the phenomenon of resonance;
• Use the Euler-Lagrange equations to analyze a conservative physical system and derive the differential equations of motion for it;
• Analyze the rotational motion of an object even if it is not rotating around one of its principal axes;
• Calculate the motion of a particle in a non-inertial reference frame, including fictitious forces such as the centrifugal and Coriolis forces;
• Articulate the important features of chaos, recognizing when systems are likely to be chaotic, and how it is different from true randomness.

Students will practice these skills and abilities during in-class and exercises and during homework assignments. Student mastery will be assessed in six midterm and one final exam.

Assignments and Grading

<table>
<thead>
<tr>
<th>Assignments</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Take-Home Midterms</td>
<td>32.5%</td>
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<tr>
<td>In-Class Midterms</td>
<td>32.5%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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<tr>
<td>Reading Questions</td>
<td>5%</td>
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<tr>
<td>Homework Assignments</td>
<td>10%</td>
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Midterms come in two forms. Each time there is an exam, there will be both an in-class exam and a take-home exam. The in-class exam is material that can be completed in class; it will emphasize conceptual understanding and basic setting up of simple problems. The in-class exams will be closed book, but you do not need to memorize any formulas; anything relevant to the exam will be written on the board.

The take-home exam will include problems that could not be completed in one hour. You are expected to complete the midterms on your own, using your course notes, the course textbook, any
materials I’ve made for you directly on the course website, and anything directly linked from the course website. You may consult with nobody other than the course instructor on the midterms. You may not seek out and use other resources on the web, except for pages directly linked from the course website. You are encouraged to start the midterm exams well before they are due, so that you will have the opportunity to ask questions of the course instructor while you’re taking the exam.

The Final Exam will also be a take-home exam, and will be due during finals week on the date and time when the final for this class would normally be administered. You will be allowed to use all of your course notes and the textbook for the final exam. The final exam will be cumulative for the whole course.

Reading Questions are on-line questions that you are expected to answer each day after you’ve completed the reading assignment for that day. They will be due a few hours before class begins. I will be reading through these reading questions to get a sense as to how much you got out of the reading, so that I might figure out what needs the most attention during class. Your score on the reading questions is based only on whether or not you made an honest effort; the correctness of the reading questions is not part of your grade.

Homework Assignments will be due approximately weekly. These are the assignments where you will struggle with the course material, and learn how to work with it quantitatively. I will evaluate and return the assignments. However, your grade on the assignment, as with the reading questions, will be based on whether or not you made an honest effort. It is OK to fail on the homework assignments! You can learn a lot from struggling and failing…if you take the time to learn from that and figure out where you went wrong. You should not view a homework assignment as completed when you’ve turned it in. Rather, after you get it back, you should look it over, look at the solutions, and understand where you were confused or what parts of the problems you were missing. The goal of homework assignments is for you to learn, and you will find them far more useful if you take a mindful approach to them rather than a “get it done and turn it in” approach.

Attendance

You are expected to come to every class meeting. That being said, we’re all adults here. If you are unwell, or even just excessively tired and know you won’t get anything out of the lecture, make the decision that is best for you. However, if you do miss any meetings of the course, you are still responsible for everything that happened during that course meeting, including any announcements about changes in due dates for assignments. While changes of these sorts of things will generally be announced on the course website, you should speak with a friend after any missed course meeting to make sure that you are up to date with the course. In any event, I will not rehash or summarize what happened in class for you if you miss class.

Academic Integrity

(This section was borrowed and modified from a syllabus written by Jamie McMinn.)

You are expected to comply with Westminster College’s policy on Academic Integrity, as described in the College Catalog. If you are suspected of violating this obligation, then you will be required to participate in the procedural process at the instructor level.

Examples of academic integrity violations include but are not limited to:
1. Plagiarizing another person’s published work or ideas
2. Cheating or receiving unauthorized help on assignments
3. Damaging, destroying, or stealing material from library resources
4. Using unauthorized materials during a midterm or final exam (e.g., notes that aren’t your own, homework or solutions written by other students, written or online material not explicitly permitted to you)
5. Falsifying data for laboratory experiments

For regular homework assignments, you are encouraged to work with other students. The assignment that you turn in should represent your own work and your own understanding, and should not just parrot what somebody else told you. Because homework will be graded based on your making a serious effort, there is no point in copying from somebody to get right answers. The benefit from the homework comes from struggling with it and working through it yourself, so you are the only one who you are shortchanging if you do not take full advantage of this.

The primary summative assessments for the course are the midterm and final examinations. As stated above, you may speak only with the course instructor about such examinations; you may not seek help from other students or from tutors. In addition, you may only use your own course notes, your own previous homework assignments, the course textbook, and material on the course website or directly linked from the course website. (That is, you may not follow a link on a page that you got to starting at the course website; you may only use those things linked directly from the course website.)

**Special Accommodations**

(Borrowed from a syllabus written by Jamie McMinn.)

If you have special needs that may affect your academic life during this semester, you should speak to a member of Disability Resources at x7192. Accommodations that are consistent with college policy will be considered. If you need additional assistance with your coursework and study habits, then you should contact the Learning Center at x6700. For issues that may affect your personal life this semester, please contact the counseling Center at x7340.

**Course Schedule**

The course schedule may be found online at the course website.