PHYS321 : Mechanics II

Spring 2016

Instructor:	Dr. Justin Dressel	**Time:**	Tue/Thur 11:30 – 12:45
Email:	dressel@chapman.edu	**Place:**	220B Hashinger Science Center

Office Hours: After class or by appointment.

Course Page: http://blackboard.chapman.edu

Course Description: This example-driven course continues where PHYS320 ended. Students will learn Hamilton's action extremization principle, conservation principles via Noether's theorem, Lagrangian mechanics, Hamiltonian mechanics, Hamilton-Jacobi theory, nonlinear dynamics and chaos, and special relativity. Problem solving and physical reasoning skills will be emphasized.

Prerequisites: PHYS320

Main Reference:

- *Classical Mechanics*, Douglas Gregory, Cambridge University Press, 2006.

Supplemental Texts:

1. *Advanced Mechanics*, S. G. Rajeev, Oxford U. Press, 2013.
2. *Introduction to Classical Mechanics*, David Morin, Cambridge U. Press, 2007.

Course Learning Outcomes:

1. Derive classical equations of motion from Hamilton's principle of extremized action.
2. Derive conservation laws using Noether's theorem, and apply those laws to physical problems.
3. Formulate mechanical problems in an appropriate mathematical form, and carry out the required computations to achieve the successful solution of those problems.
4. Simplify analytical models to effective models, while quantifying the domains of applicability.

Program Learning Objectives:
Upon graduation, students will:

1. Demonstrate knowledge and understanding of basic mathematics and physical principles used to model natural phenomena.
2. Demonstrate ability to convey physical concepts with mathematical expressions and/or computation, and effectively derive quantitative predictions from a model through mathematical/computational analysis.

3. Demonstrate competency in using computer tools.
4. Demonstrate the ability to apply advanced knowledge of advanced mechanics, electromagnetism, thermodynamics and quantum physics to the solution of problems in physics.
5. Demonstrate the ability to effectively communicate information, scientific or otherwise, in both written and verbal form.
6. Demonstrate the ability to write clear, organized and illustrated technical reports with proper references to previous work in the area.
7. Demonstrate the skills and motivation for continued self-education.

Grading Policy:
Homework (50%), Take-home Midterm Exam (20%), Take-home Final (30%).

Organization:
This course will hone a set of professional problem solving skills, which means practice is essential. As such, you are expected to turn in work of professional quality. No messy work or tentative scratch work will be accepted. Final solutions should be self-contained, including the problem statement and a logical presentation of the solution with an explanation in words of what is being done and why. Solutions should be typed in LaTeX, and illustrated with plots as appropriate. Half of your job is solving interesting problems; the other half of your job is presenting the results of your work as a qualified professional.

The bulk of lecture time will be spent emphasizing points of derivation and solving interesting physical problems together. It is your responsibility to read the relevant material in the textbook, and come to class prepared to learn. Homework will be assigned weekly and will be challenging, so group collaboration is encouraged to iron out ideas and solution strategies. However, your final solutions must be written up *independently* and in your own words—duplicate work will be taken very seriously and treated as plagiarism. The midterm and the final will be take-home exams to allow adequate time for writing up careful solutions and demonstrating your expertise.

Slack:
Group discussion and contact with the professor will be facilitated by Slack, at `http://scststudents.slack.com`. Please notify the instructor if you need to be invited. The channel for this course will be `#phys321-sp16` and is set to auto-notify the instructor. Note that this is a public forum, but private chats are also available as required.

SageCloud:
In the eventuality that computational assistance is required, we will be using `http://cloud.sagemath.com` as a browser-based coding solution. It is your responsibility to ensure that you have an account, and that you create a project PHYS321 for this course. In addition to the Sage computational engine, your account will give you access to a virtual Linux machine running Ubuntu, complete with an accessible bash terminal, LaTeX, `vim` and `emacs`, Jupyter notebooks, Numeric Python, Scientific Python, Pandas, C, C++, Julia, and many other useful tools. Your problem solutions should indicate which tools were used when appropriate.

Approximate Course Outline:

Week	Dates	Topics	Reading
1	2/2, 2/4	Energy conservation	§9.1—9.4
2	2/9, 2/10	Momentum conservation	§10.1—10.10
3	2/16, 2/18	Angular momentum conservation	§11.1—11.7
4	2/23, 2/25	Lagrangian mechanics I	§12.1—12.5
5	3/1, 3/3	Lagrangian mechanics II	§12.6—12.10
6	3/8, 3/10	Hamilton's action principle (Midterm exam assigned)	§13.1—13.4
7	3/15, 3/17	Hamiltonian mechanics (Midterm exam collected) *(Instructor at APS March Meeting)*	§14.1—14.5
8	3/22, 3/24	**Spring Break**	
9	3/29, 3/31	Hamilton-Jacobi theory	Supp. 1, §9.1—9.6
10	4/5, 4/7	Small oscillations and normal modes	§15.1—15.8
11	4/12, 4/14	Rotating reference frames	§16.1—17.4
12	4/19, 4/21	Tensor algebra and inertia	§18.1—18.7
13	4/26, 4/28	Rigid body dynamics	§19.1—19.10
14	5/3, 5/5	Chaotic dynamics	Supp. 1, §11—12, 15.3
15	5/10, 5/12	Relativistic mechanics (Final exam assigned)	Supp. 2, §11.1—13.6

Chapman University Academic Integrity:

Chapman University is a community of scholars which emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work, and academic dishonesty of any kind will not be tolerated anywhere in the university. At their discretion the faculty may submit work to plagiarism detection software, such as www.turnitin.com for review.

Students with Disabilities:

In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to contact the Office of Disability Services. If you will need to utilize your approved accommodations in this class, please follow the proper notification procedure for informing your professor(s). This notification process must occur more than a week before any accommodation can be utilized. Please contact Disability Services at (714) 516-4520 or http://www.chapman.edu/students/studenthealth-services/disability-services if you have questions regarding this procedure, or for information and to make an appointment to discuss and/or request potential accommodations based on documentation of your disability. Once formal approval of your need for an accommodation has been granted, you are encouraged to talk with your professor(s) about your accommodation options. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course.

Equity and Diversity:

Chapman University is committed to ensuring equality and valuing diversity. Students and professors are reminded to show respect at all times as outlined in Chapmans Harassment and Discrimination Policy: http://ow.ly/XEwTu Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.