SFSU Physics 330: Analytic Mechanics I

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Lectures & Office Hours

Lectures: Tuesday 11:00-12:15, Thursday 11:00-12:15, Thornton 425.
Office Hours: Monday 14:00-16:00, Thursday 12:30-15:30, Thornton 308
Help Session: TBD

Quick note on e-mail contact

So that I can identify and respond to e-mails from you expeditiously, please put [PHYS330] at the beginning of the subject line. Your emails should have a salutation/greeting, a body written in standard English with correct spelling & grammar, and a closing/signature. I will respond to emails within 48 hours.

Course Overview

Physics 330 is an intermediate course in "classical" Newtonian mechanics. In the first part of the course, we quickly review the same material as in Physics 220 (kinematics, Newton's Laws of Motion, oscillatory motion, work & energy, linear momentum, angular momentum & torque), but at a more mathematically sophisticated level, making full use of vector calculus, linear algebra, and ordinary differential equations. New topics include central-force motion, calculus of variations, Lagrangian dynamics, and Hamiltonian dynamics.

Course Objectives

(1) To analyze real-world systems in mechanics, to make valid approximations and develop simplified models of such systems, and then to apply Newton's Laws of Motion to determine the system's evolution.
(2) To develop and apply mathematical tools (vector calculus, linear algebra, differential equations, calculus of variations, numerical/computational methods) to solve problems in classical mechanics.
(3) To understand and apply the fundamental conservation principles of classical physics (energy, linear momentum, and angular momentum).

Required Learning Materials

(1) An Introduction to Mechanics by Kleppner & Kolenkow, 1st ed. McGraw-Hill, Inc., 1973.
(2) An Introduction to Lagrangian Mechanics by Brizard, 1st ed. World Scientific Publishing Co., 2008.
(3) Access to mathematical software such as Matlab, Mathematica, IDL, Excel.

Important Websites

(1) www.physics.sfsu.edu – Department of Physics & Astronomy
(2) ilearn.sfsu.edu (note: no www in web address) – Login to access course website. Please check frequently for new announcements, updates to the syllabus & schedule and links to additional learning resources.

Prerequisites & Corequisites

(1) Math 245 (Elementary Differential Equations & Linear Algebra), or for a more rigorous treatment, both Math 325 (Linear Algebra) & Math 376 (Ordinary Differential Equations I).
(2) Physics 230 (General Physics with Calculus II).

In addition to the above prerequisites, students are strongly encouraged to co-enroll in:
(3) Physics 385 (Introduction to Theoretical Physics).
Please see me if you have any concerns about your preparation.

Assignment of Grades

Grades will be determined according to the following rubric:

Homework: 15 % or 30% Best 6 of 8 Quizzes: 15% or 30% Final Exam: 40% or 55% or 70%

If your final exam score is better than homework and/or quiz average, then those components are worth 15% and the the final exam is worth correspondingly more. There are no make-up quizzes for any reason. Letter grades will assigned according to the following scheme:

	A: 90.0% – 100.0%	A-: 85.0% – 89.9%	
B+: 80.0% – 84.9%	B: 75.0% – 79.9%	B-: 70.0% – 74.9%	
C+: 65.0% – 69.9%	C: 60.0% – 64.9%	C-: 55.0% – 59.9%	
D+: 50.0% – 54.9%	D: 45.0% – 49.9%	D-: 40.0% – 44.9%	F: 00.0% – 39.9%

Homework

You cannot learn physics solely from lectures. You must work through many problems, seeing how the theoretical concepts discussed in lecture apply in various contexts. Homework is an integral part of the learning process; how serious you take the homework will ultimately determine how much you will understand physics and how well you will do in the course overall. There will be approximately one homework assignment per week. Most problems will require analytic solutions, however there will usually be one problem per assignment that will involve graphing and numerical solution with computer software such as Microsoft Excel, MATLAB, Mathematica, or IDL.

You can turn in one assignment up to one week late for any or no reason, with no penalty. After that, unexcused late homework assignments will be penalized 10% per day, including weekend days. All requests for excused lateness will require external documentation.

Policy on Collaboration & Academic Integrity

You are strongly encouraged to discuss course material with your fellow classmates. When working on homework, first try to solve the problems on your own. Struggle. Struggle some more. If you get stuck, feel free to discuss overall methods and approaches with your classmates, but not the details! Your written solutions should be solely your own, and should be written-up in isolation from your fellow classmates. Copying is strictly prohibited. Cheating via any method on exams will result in a grade of zero on that exam and being reported to the department chair and/or college dean for possible discipline. Please see the official plagiarism and academic ethics policies for the Department of Physics & Astronomy at: www.physics.sfsu.edu/Academics/Policy.html.

Drop, Withdrawal & Repeat Policy

The "Drop" deadline is Monday, September 9. You can drop yourself from the class online without any penalty and without any record, for any reason. After September 9, students must petition for an official "withdrawal." Documents must be provided to support the petition to withdraw. If the petition is approved, the designation "W" will appear on the transcript. Students are only allowed to repeat a class once at SFSU. Note that designations of W, WU, NC count toward this limit.

Expected Code of Conduct

Classroom discussion and participation are strongly encouraged. However, please refrain from unrelated chatter. Also, please remember to place cell phones and other electronic communication devices on silent or vibration mode so as not to distract your fellow classmates. If you must arrive late or leave early, please sit toward the back of the room near the doors so as to minimize disruption.

Disability Access

Students with disabilities who need reasonable accommodations are encouraged to contact me early in the semester. The Disability Programs and Resource Center is available to facilitate the reasonable accommodations process. The DPRC, located in Student Services Building 110, can be reached by phone at 415-338-2472 (voice/TTY) or by e-mail at dprc@sfsu.edu.

Religious Holidays

The faculty of San Francisco State University shall accommodate students wishing to observe religious holidays when such observances require students to be absent from class activities. It is the responsibility of the student to inform the instructor, in writing, about such holidays during the first two weeks of the class each semester. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed.

Outline of Topics

Kinematics [2 weeks]: Derivatives of vectors applied to position, velocity and acceleration; general motion in 3D and the Frenet-Serret formula; motion in polar/cylindrical coordinates.

Particle Dynamics [2 weeks]: Newton's Laws of Motion; force problems with constraints; variable tension along ropes with mass; position-dependent forces in 1D; velocity-dependent drag forces; damped linear oscillations; forced oscillations and resonance; coupled oscillations.

Work & Energy [1 week]: Work-kinetic energy theorem; line integrals; Stokes's theorem and conservative forces; potential energy functions; small oscillations around stable equilibria.

Linear & Angular Momentum [3 weeks]: Impulse-momentum theorem; conservation of momentum for systems of particles; momentum flow problems and the rocket equation; angular momentum of point particles and extended objects; inertia tensor; planar motion; rigid body motion; precession.

Central Forces [2 weeks]: Equations of motion; conservation of energy and angular momentum; exact solution to 2-body problem; Kepler's Laws; perturbations to circular orbits; changing orbits.

Calculus of Variations [1 week]: Derivation of Euler-Lagrange equations; application to minimization problems in physics.

Lagrangian Dynamics [3 weeks]: Generalized coordinates; virtual work & d'Alembert's Principle; Lagrange's equations; minimization of action; application to problems with static and moving constraints; ignorable coordinates and conservation laws.

Hamiltonian Dynamics [1 week]: Derivation and application of Hamilton's equations; cyclic coordinates; Noether's theorem; Liouville's theorem.

Final Exam: Thurs., Dec. 19, 2013, 10:45 - 13:15