PHYSICS 404. Classical Mechanics.

Instructor:	Tim Gorringe.
Office:	CP273.
Phone:	257-8740.
Textbook:	Analytical Mechanics, Fowles and Cassiday, 7^{th} Ed.
Web page	www.pa.uky.edu/∼gorringe/phy404
Office hours:	T 2:00 - 3:00.
	R 2:00 - 3:00.

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1 Course Objectives.

Classical mechanics is the study of the motion of material bodies. The subject isn't considered a glamorous field like black holes or super-strings, but rather as an essential foundation of our physics knowledge. For example, the concepts of symmetries principles and conservation laws, that originated in mechanics, are central themes in physics today. Consequently, a solid understanding of mechanics represents the groundwork for everything to follow.

In PHY404 we will explore fundamental laws such as Newton's laws of motion, fundamental concepts such as conservation of energy and momentum, and apply these ideas in understanding a rich variety of motion. On route we'll uncover the remarkable work of physics giants like Galileo, Kepler, Newton and Lagrange. We will examine the gravitational force and develop a detailed understanding, both conceptually and mathematically, of the motion of the planets and the tides. We'll examine motion in one, two and three dimensions and involving single particles, rigid bodies and systems of particles.

As we go, we shall assemble a problem solvers tool box for tackling a wide variety of real-life mechanics problems. Our tool box will include such items as vector algebra, matrix algebra, differential equations and vector calculus. Most importantly, we shall develop the knowledge and experience to take a real-life problem, to model it mathematically, and uncover its solution. Such skills are essential for every budding physicist.

2 Course Prerequisites.

The prerequisites for this course are two semesters of general university physics (*i.e.* the PHY231/232 sequence) and calculus III (MA213). The course includes a short review of vector algebra, coordinate

systems, differential equations and vector calculus.

3 Course Grading.

Your final grade will be based on homework, two one-hour tests, and a two-hour cumulative final. In addition a 1% bonus is given for completing the online instructor and course evaluation at the end of the semester. The contributions of the different components to your final grade, and the dates of the tests and the final, are given below.

source	date	contribution
homework		20%
test one	M Oct 9	20%
test two	F Nov 17	20%
cumulative final	8:00-10:00*am* W Dec 13	40%
evaluation bonus	16 Nov. - 6 Dec.	1%

4 Homework assignments.

Typically two homework problems will be assigned per lecture class. Each Friday the homework assignments from the preceding Friday, Monday, and Wednesday classes will be collected. You are encouraged to get together with your fellow students to discuss the homework problems, but your homework solutions must be written–up independently. Late homework isn't accepted.

Hmwk.	Problems
#1	2-1,2,3,47,10
#2	2-11,12,18 3-1,2
#3	3-6,7,8,9,10
#4	3-11,12,16 1-1,7,14,15,17
#5	1-18,21,28,29 4-1,2.3,4
#6	4-16,18,19,20,21,22,
#7	5-1,4,5,8
#8	5-11,13 6-1,2,3
#9	6-5,7,17,18
#10	7-1,2,3,4,5
#11	7-14,16,18 8-4,6,10,15
#12	10-3,4,7,10

The homework assignments are listed above and the homework solutions with be made available in the Chem-Phys library. See the class schedule for the due dates.

5 Course evaluations.

Course evaluations are an important component of our instructional program. Our on-line course evaluation was developed to allow each student ample time to complete the evaluation of the course and the instructor. The evaluation window for Fall 2006 will open on Thursday, Nov. 16 and close on Wednesday, Dec. 6. To access the system go the physics department web page at www.pa.uky.edu and click the course evaluations link.

6 Important dates.

Classes begin on Wednesday, August 23, and end on Friday, December 8. During the semester there are several academic holidays: labor Day - Monday, Sept. 4, fall break - Friday, Oct. 6, and Thanksgiving - Thursday-Friday, Nov. 23-24. The last day to drop a course is Friday, October 20.

7 Course Content.

PHY404 meets M–W–F from 9:00pm to 9:50pm in room CP183. The following table gives the topics we will cover during the semester. The second column gives the relevant section in the text book.

Lec.	Date	Topic	Chap.	Hmwk
1	W Aug 23	Intro to space/time, Newton's laws, conserved quantities	1.1-2/2	
2	F Aug 25	Intro to space/time, Newton's laws, conserved quantities	1.1-2/2	
3	M Aug 28	Examples of 1D motion with conservative forces	2	
4	W Aug 30	Examples of 1D motion with non-conservative forces	2	
5	F Sep 1	Hyperbolic functions, trigonometric functions, and more	2	#1
–	M Sep 4	**Labor Day Holiday**		
6	W Sep 6	Theory and examples of simple harmonic motion	3	
7	F Sep 8	Energy concepts, phase diagrams and more examples	3	#2
6	M Sep 11	Theory and examples of damped harmonic motion	3	
9	W Sep 13	Energy concepts, phase diagrams and more examples	3	
10	F Sep 15	Theory and examples of driven harmonic motion	3	#3
11	M Sep 18	Coordinate systems, coordinate transforms	1.	
12	W Sep 20	Vectors derivatives in rectangular, cylindrical coords	1.	
13	F Sep 22	Vectors derivatives in cylindrical, spherical coords	1	#4
14	M Sep 25	Newton's laws in 3 dimensions and energy and work	4	
15	W Sep 27	Examples of 2/3-D motion and the harmonic oscillator	4	
16	F Sep 29	Examples of 2/3-D motion in a gravitational field	4	#5
17	M Oct 2	Examples of 2/3-D motion in an electromagnetic field	4	
18	W Oct 4	Chaotic motion	4	
–	F Oct 6	**Academic Holiday**	1,2,3,4	
19	M Oct 9	**Test One**		
20	W Oct 11	Non-inertial frames of reference (translational)	5	
21	F Oct 13	Examples with rail cars, ...	5	#6
22	M Oct 16	Non-inertial frames of reference (rotational)	5	
23	W Oct 18	Examples of plumb line, ...	5	
24	F Oct 20	Example of Coriolis force, Foucault pendulum, ...	5	#7
25	M Oct 23	The discovery of gravity	6	
26	M Oct 25	Gravitational force due to uniform solids	6	
27	F Oct 27	Conics, ellipses, parabolas, hyperbolas, ...	6	#8
28	M Oct 30	Kepler's laws; discovery and understanding	6	
29	W Nov 1	Potential energy, angular momentum and gravity	6	
30	F Nov 3	Systems of particles, kinetic energy, linear momentum	7	#9
31	M Nov 6	Examples with particles, springs, ...	7	
32	W Nov 8	Systems of particles, internal/external forces	7	
33	F Nov 10	Examples of Potter's wheel, mass on string, ...	7	#10
34	M Nov 13	Two body problem and planetary motion	7	
35	W Nov 15	Collisions: elastic, inelastic, equal masses, heavy-light	7	
36	F Nov 17	**Test Two**	5,6,7	
37	M Nov 20	Center of mass, moment of inertia, and related theorems	8	
38	W Nov 22	Examples with pulleys, disks, ...	8	
–	F Nov 24	**Thanksgiving Holiday**	8	
39	M Nov 27	Examples with pulleys, disks, ...		
40	W Nov 29	Principle of least action in classical mechanics	10	
41	F Dec 1	Deeper understanding of least action	10	#11
42	M Dec 4	Variational calculus, generalized coordinates, ...	10	
43	W Dec 6	Examples and applications of least action	10	
44	F Dec 8	Examples and applications of least action	10	#12
–	W Dec 13 8-10 am	**FINAL**		