PHYS522 – Mechanics – Spring 2008

Lecture: Tu/Th, 11:30-12:45 a.m. CW 023
Recitation: M 3:30 p.m. CW 023

Textbook: *Classical Mechanics*, John R. Taylor

Suggested References: *Classical Dynamics of Particles and Systems*, Thorton and Marion; *Analytic Mechanics*, Fowles; *Classical Mechanics*, Goldstein; *Mathematical Methods for Physicists*, Arfken and Weber;

Instructor: Dr. Brian R. Washburn
CW 36B, (785) 532-2263; washburn@phys.ksu.edu
Office hours: M/W/F 9:30-10:30 PM or by appt.

Purpose and Goals: The purpose of this course is to expose you to advanced formalisms of classical mechanics, thus introducing the foundation for other areas of physics. Another important purpose is to for you to develop a strong conceptual understanding of mechanics, and to develop the problem-solving techniques needed to handle sophisticated problems in classical mechanics.

The overall goals of this class are:

- Introducing "new" formalisms of classical mechanics and how these formalisms are related to other areas of physics.
- Expanding your current knowledge of mechanics.
- Introducing the concept of symmetry and its relationship to conservation principles.
- Developing essential mathematical and numerical methods and tools.
- Improving your writing and problem-solving skills
- Improving your conceptual understanding of mechanics, and your ability to communicate your knowledge.

Grading:

Exam 1	100 pts	200 pts
Exam 2	100 pts	
Final Exam		300 pts
Homework		480 pts
Quizzes		20
Total possible		**1000 pts**

Exams: There will be two exams plus a cumulative final exam. The exams will either be in-class or a take home exam, to be agreed upon by the class and instructor.

In-Class Quizzes: Surprise quizzes on the reading material may be given during the lecture or recitation. The purpose of the quiz is the make you read the book *before* attending class.

Homework: It is expected that you will learn the course material mostly by completing the homework. Note that the **course material will be challenging**, so you will need to work hard on the homework to be successful. Homework assignments will be given approximately once per week and will take about 10 hours. Discussing the homework with your classmates is encouraged but you should be able to write up the assignment on your own. In the case when you get stuck on a problem, credit will be given for a statement indicating how your solution is incorrect.

Guidelines for the homework:

- Read the textbook before doing the homework
- Draw a detailed diagram, write down the given variables, and write out what is to be found.
- Think about the solution beforehand, and then see if the guess corresponds to your solution.
- Discuss the homework with your classmates but write the homework out on your own.
- Ask thoughtful questions if you get stuck.
- It is important for you, the scientist in-training, to learn how to communicate scientific information in a clear and precise manner. It is your responsibility to present the homework solutions in a readable and logical manner. If this is not done there will be a grade penalty.

Disabilities: If you have any condition such as a physical or learning disability, which will make it difficult for you to carry out the work as I have outlined it or which will require academic accommodations, please notify me and contact the Disabled Students Office (Holton 202), in the first two weeks of the course.

Plagiarism: Plagiarism and cheating are serious offenses and may be punished by failure on the exam, paper or project; failure in the course; and/or expulsion from the University. For more information refer to the "Academic Dishonesty" policy in K-State Undergraduate Catalog and the Undergraduate Honor System Policy on the Provost's web page: http://www.ksu.edu/honor/.

Tentative Course Schedule, Mechanics PHYS 522, Spring 2008

Date	L/R	Topic	Book	Homework
Jan. 17 (Th)	L1	Course introduction, review of Newton's laws	Ch. 1	
Jan. 21 (M)		*** Student Holiday ***		
Jan. 22 (Tu)	L2	Forces and torques, linear and angular momenta	Ch. 1	
Jan. 24 (Th)	L3	Cylindrical coordinates, projectile motion with air resistance	Ch. 2	HW1 Due
Jan. 28 (M)	R1	Velocity and acceleration in different coordinate systems, HW1		
Jan. 29 (Tu)	L4	Linear and quadratic air resistance	Ch. 2	
Jan. 31 (Th)	L5	Motion of a charge in a uniform magnetic field	Ch. 2	HW2 Due
Feb. 4 (M)	R2	Introduction to differential equations, Go over HW2		
Feb. 5 (Tu)	L6	Conservation of momentum, center of mass	Ch. 3	
Feb. 7 (Th)	L7	Angular momentum of single and several particles	Ch. 3	HW3 Due
Feb. 11 (M)	R3	Numerical methods of integration, Go over HW3		
Feb. 12 (Tu)	L8	Work, kinetic energy and potential energy	Ch. 4	
Feb. 14 (Th)	L9	Conservation of energy, force as the gradient of potential energy	Ch. 4	
Feb. 18 (M)	R4	Numerical methods for differential equations		
Feb. 19 (Tu)	L10	Simple harmonic motion, phase space pictures	Ch. 5	
Feb. 21 (Th)	L11	Damped oscillations and resonance	Ch. 5	HW5 Due
Feb. 25 (M)	R5	The Fourier series		
Feb. 26 (Tu)	L13	Driven damped oscillations	Ch. 5	
Feb. 28 (Th)	L14	More oscillations: frequency of small oscillations	Ch. 5	HW6 Due
Mar. 3 (M)	R6	Review for Exam 1		
Mar. 4 (Tu)		Exam 1		
Mar. 6 (Th)	L15	Nonlinear oscillations and chaos	Ch. 12	
Mar. 10 (M)	R7	Go over Exam 1		
Mar. 11 (Tu)	L16	The calculus of variations	Ch. 6	
Mar. 13 (Th)	L17	Lagrangian mechanics and Hamilton's principle	Ch. 7	HW8 Due
		*** Spring Break: March 17-21 ***		
Mar. 24 (M)	R8	Coupled differential equations, HW 8		
Mar. 25 (Tu)	L18	Generalized coordinates and constraints	Ch. 7	
Mar. 27 (Th)	L19	Problems in Lagrangian mechanics: frequency of small oscillations	Ch. 7	HW9 Due
Mar. 31 (M)	R9	Go over HW9		
Apr. 1 (Tu)	L20	Lagrangian multipliers and constraints	Ch. 7	
Apr. 3 (Th)	L21	Conservation laws revisited!, Noether's theorem	Ch. 7	HW 10 Due
Apr. 7 (M)	R10	Go over HW10		
Apr. 8 (Tu)	L22	Hamiltonian dynamics, formalisms in physics	Ch. 13	
Apr. 10 (Th)	L23	Two-body central force problems, reduced mass	Ch. 8	HW 11 Due
Apr. 14 (M)	R11	Go over HW11, plotting potentials by hand		
Apr. 15 (Tu)	L24	Effective potentials, stable orbits	Ch. 8	
Apr. 17 (Th)	L25	Kepler's problem	Ch. 8	HW 12 Due
Apr. 21 (M)	R12	Review for Exam 2		
Apr. 22 (Tu)		Exam 2		
Apr. 24 (Th)	L26	Mechanics in noninertial reference frames	Ch. 9	
Apr. 28 (M)	R13	Go over Exam 2		
Apr. 29 (Tu)	L27	Rotational motion of rigid bodies, moment of inertia tensor	Ch 10	
May 1 (Th)	L28	Euler's equations, gyroscopes	Ch. 10	HW 13 Due
May 5 (M)	R14	Linear algebra: Eigenvectors and eigenvalues, HW13		
May 6 (Tu)	L29	Coupled oscillators	Ch. 11	
May 8 (Th)	L30	Coupled oscillators and normal coordinates	Ch. 11	HW 14 Due
May 15 (Th)		Final Exam 9:40 a.m. - 11:30 a.m.		