

# Classical Mechanics – Fall 2003

## PHYS-330

Instructor: Asst. Prof. Nathan L. Harshman  
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**Classroom:** McKinley 15

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**Class meeting times:** Tuesday and Friday, 3:35-4:50PM

**Office hours:** Tuesday 11-12noon, Wednesday 1-3PM, Friday 10-11AM, or by appointment

**Course description and goals:** Classical mechanics introduces many of the fundamental concepts and mathematical techniques upon which the rest of theoretical physics is built. It underpins the mechanical, structural and civil engineering that makes much of modern life possible. It combines common sense and mathematical rigor to bring uncommon clarity to the macroscopic world around us.

Roughly, the topics we will cover are the motion and dynamics of point particles, rigid objects, and interacting collections of such objects. The dynamical forces we consider in most detail will be gravity, the harmonic (Hooke's) force, and contact forces like the normal force and friction. We will begin with Newton's formulation of dynamics and later learn Lagrangian and Hamiltonian dynamics and the power of the Principle of Least Action.

The course presupposes a solid mathematical background through MATH-223. Concurrent enrolment in or completion of a differential equations class, such as MATH-321, would be helpful but is not required.

### **Course Materials:**

**Text:** *Classical Mechanics of Particles and Systems*, Thornton and Marion,  
Brooks/Cole—Thomson Learning, ISBN 0-534-40896-6

**Optional Text:** *Student Solution Manual for Classical Mechanics of Particles and Systems*

**Calculator:** Scientific calculator.

**Matlab:** We will be using the computer program Matlab in class and on some homework assignments, as well as on the semester project. No prior knowledge of Matlab is expected; you will develop the skills as we go along. Matlab will be available to you in the departmental computer lab.

**Communication:** This course will use the Blackboard system of American University for distribution of information outside of class time.

**Email:** You must have an American University email account to use this system; if you use an email provider other than American, forward your American mail to that account. On-line quizzes will be taken through Blackboard, on-line discussion sessions will be managed through Blackboard, and solutions to homework and tests will be posted on Blackboard. Check your email and the class website of Blackboard frequently to stay up-to-date. I usually respond fairly promptly to email and it is my preferred method of communication outside of class and office hours.

**Discussion Boards:** Please make use of the discussion boards to ask questions, vent frustrations, share neat ideas or website, etc.

**Privacy:** For the record, I can track Blackboard viewing, i.e. count the hits on each page and see who accessed it. However, you can post on the discussion board anonymously, and I really can't see you said it.

**Etiquette:** Express yourself freely in this class, in email and on Blackboard. However, be respectful and polite to your fellow students.

**Course requirements and grading:** Your final grade will be based on the following:

Homework	30%
Class Participation	5%
Projects	30%
Exam I	10%
Exam II	10%
Final	15%

**Grading scale:** Your grades and the class average grades will be released periodically throughout the semester. Students at risk for receiving a C- or lower will be notified midway through the semester. The grading scale below is guaranteed to be the maximum requirements for a grade, but may be adjusted lower to account for class performance.

A	>	93%
A-	>	90%
B+	>	87%
B	>	83%
B-	>	80%
C+	>	75%
C	>	65%
C-	>	60%
D	>	45%

**Homework:** Ten times during the semester assigned homework will be required to be turned in. The homework assignments will be posted on Blackboard at least one week before the due date. You may work with others to complete these assignments, but you must turn in your own work. You may not copy the homework from someone else, as that is a violation of the AIC. You are encouraged to attempt all the homework on your own before seeking assistance, but you are also strongly encouraged to form study groups and come to office hours. The homework will be due in class on Fridays with no extensions possible except for excused absences (see below).

**Class Participation:** To receive the full 5% for class participation, you must attend every class and participate.

**Project:** By the end of the seventh week of class, you will choose a physical system to study in great detail. A list of topics will be provided or, after consulting with me, you can choose your own. Early in the semester a sample project will be posted on Blackboard. This project will be structured into a proposal and five “approaches” to the physical system. The five approaches are:

Analytical—Do a thorough theoretical analysis of the system’s kinematics and dynamics, using Newtonian, Lagrangian and/or Hamiltonian dynamics. Consider limiting and exceptional cases and do analytical approximations where necessary.

Numerical/Computational—Construct a numerical simulation of various aspects of the problem. The computer program MatLab will assist you with this. For example, integrate the dynamics for various initial conditions; analyze regions of stability; etc. Produce plots and graphs of result.

Practical—Build a model or investigate real-world physical examples and approximate to your system.

Literature/History—Investigate the scientific and pedagogical background of your system. Produce a bibliography that will help you complete the rest of the project.

Presentation/Pedagogy—Produce a presentation appropriate for undergraduate physics majors about your system. This presentation should be able to be viewed on-line and posted on Blackboard or other website.

Many more details will be given as the semester progresses and I will be helpful in helping you achieve success with this project. The proposal and one approach section will be due 10 October, both will be evaluated, but only the proposal will receive a grade. Three approaches (including the revised version of the approach previously submitted) will be due 11 November and the revised approach will be graded. The completed final project will be due Monday, 8 December in my office.

**Exams and Final:** There will be two in-class exams and a final during the final exam period. They will be closed-notes and closed-book. A list of possible test questions will be provided before each exam and you are encouraged to prepare responses, although you cannot bring prepared responses to the test. Exam II and the final are both cumulative. Test results and answer keys will be posted on Blackboard.

**Succeeding in this class and getting help:** To succeed in this class, it is imperative that you interact with the material every day. Physics is like a foreign language, you cannot learn it just from attending class. Make sure you do the readings before class, do all the quizzes and homework, solve the sample test questions, come to office hours. This is a three-hour class, so you should spend *at least* six hours a week outside of class time thinking about and practicing physics.

**On-line discussions:** On Blackboard there will be on-line discussion groups. You can you this to ask me questions publicly, discuss homework with your peers and voice concerns and opinions about the material and the class.

**Office hours:** You are super-welcome to come to office hours. We have a good time there. If you can't make any of the times listed above, call or email me and we can work something out.

**Students with disabilities:** Please contact me if you have any special needs.

**Academic Integrity Code:** Read it and follow it. It is your responsibility to know it and abide by it. Follow all instruction given here or given on a specific assignment or the full due process of the AIC will come down on you.

**Excused absences and extensions:** Severe illness, religious observance, University business, and family emergency are acceptable reasons for missing class or needing an extension on an assignment. I have the right to request reasonable documentation, in accordance with University policy. Do not notify me of an absence, such as missing an exam or needing an extension, at the last minute. Use email and notify as far in advance as possible.