

# PHYS 315

## Analytical Mechanics

Mount Holyoke College – Spring 2009

Meeting Times:

(LECTURE) Cleveland 003L – TTh 1:15p – 2:30p [**\*\*the location may change\*\***]

Instructor: <b>Rob Salgado</b> <b>Visiting Assistant Professor of Physics</b> Office: <b>Kendade 215</b> Voice: <b>(413)-538-2816</b>	Email (the best way to contact me): <b>rsalgado@mtholyoke.edu</b> Instant-Messengers: AOL, MSN[hotmail], Yahoo: <b>mhcpyrob</b> (do <i>not</i> email here)	Office hours: <b>-to be announced</b>
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Catalog Description:

**PHYS 315 – Analytical Mechanics (4 credits) - [64650]**

Newton's great innovation was the description of the world by differential equations, the beginning of physics as we know it. This course studies Newtonian mechanics for a point particle in 1, 2, and 3 dimensions, systems of particles, rigid bodies, and the Lagrangian and Hamiltonian formulations. [*Prerequisite: PHYS 303.*]

Required Textbook:

**“Classical Dynamics of Particles and Systems (5th ed)”**,

Stephen T. Thornton and Jerry B. Marion [Brooks-Cole/Cengage (2003), ISBN: 978-0534408961]

*Optional supplement that may be useful to you:*

“Schaum’s outline of theory and problems of Lagrangian dynamics”, Dare A. Wells  
 [Schaums (1967), ISBN: 978-0070692589]. (MH Library reserve)



Electronic Materials:

I will maintain a website (for now: <http://www.mtholyoke.edu/courses/rsalgado/315/> )

that links to homework assignments, solutions (on **ella**), electronic-whiteboard notes, handouts, other resources (including Java applets), and source-code for visualizations in Maple or Python.

(These materials are not a substitute for regular attendance, participation, and problem-solving.)

Course Goals:

- A. To further develop concepts in mechanics, especially energy methods.
- B. To reinforce important concepts in physics and mathematics.
- C. To further develop physical intuition, mathematical reasoning, and problem solving skills.
- D. To further prepare students for the necessarily rigorous sequence in physics, mathematics, engineering, and other physical sciences.

Course Requirements:

Come to class **ON TIME, AWAKE, and ALERT (to the physics topic under discussion)**.

Attendance is **REQUIRED**.

Come to class PREPARED and EQUIPPED, having read or written any assignments.

Grades are roughly weighted as follows:

40% HOMEWORK (including pre-class assignments)

15% each EXAM #1, #2, #3 (open notes, open-text, take-home)

15% LAST EXAM (required\*, open notes, open-text, take-home)

\* means that “*You cannot earn a passing grade without this item*”

Grades will be maintained on **ella**, and you will be alerted when a new item is posted. ***You have one (1) week to contest (by email) any grade or any missing item.*** Requests for re-grading must be accompanied by a written explanation on the item which concisely identifies what is being contested and concisely explains (in physical or mathematical terms) why your answer is correct or why the grading is wrong. The entire assignment or exam may then be subject to re-grading, and may result in a higher total score, a lower total score, or an unchanged total score.

Homework (assigned periodically, is due in “THE BOX” by the end of class on Tuesdays):

Homework will be assigned, collected, and graded. (Late homework (penalized 15% daily, starting at the end of Tuesday’s class)

must be submitted under my door or sent as a legible scan to [mhcpyrob@gmail.com](mailto:mhcpyrob@gmail.com) (which is only to be used for large emails). )

**Most of the learning you do in this course is done by your doing homework problems outside of class!** (I am merely a guide for you.)

You are strongly encouraged to discuss the homework with other students. However, be sure that you can do the homework *by yourself* and that you present your own work. You can always ask me or (hopefully) my teaching-assistant for help after you have made an honest effort.

You are also encouraged to learn to use computational tools (like Maple or Python) to help you do calculations and create visualizations.

Missed exams:

There are no makeup exams. There are no exceptions.

If you are absent for an exam, ***within one (1) week, you must send me an email with your excuse.*** Only if that excuse is valid, your final exam will carry the weight of a missed exam. Otherwise, you will get zero credit for the missed exam. You are, of course, responsible for the content of any missed exam.

Alternate arrangements:

Requests for alternate arrangements must be ***made in advance*** and ***must be accompanied by an email addressed to me.***

I will reply by email with my decision on your request.

Presentation at the  
AAPT National Meeting  
(Chicago, Feb 14-16)

Sequence of PHYS 315 topics from selected sections of these chapters:

		Su	Mo	Tu	We	Th	Fr	Sa	
Introduction and "Quiz 0"						[ 29			JAN
(Ch 2) Newtonian Mechanics---Single Particle	2.1-2.4			3		5			FEB
	2.5-2.6			10		12			
(Ch 3) Oscillations	3.1-3.4			17	[	19	-----		
	3.5-3.8	-----	J	24		26			
*(Ch 4) Nonlinear Oscillations and Chaos	4.1-4.4, 5.1-5.2			3		5			MAR
(Ch 5) Gravitation	5.3-5.5, "Action"			10	[	12	-----		
		==B==R==E==A==K==							
(Ch 6) Some Methods in the Calculus of Variations	6.1-6.7	-----	J	24		26			
(Ch 7) Hamilton's Principle---Lagrangian and Hamiltonian Dynamics	7.1-7.4			31		2			APR
	7.5-7.8			7	[	9	-----		
	7.9-7.12	Ea	---	J	14	16			
(Ch 8) Central-Force Motion	8.1-8.4, 8.5-8.7			21		23			
(Ch 9) Dynamics of a System of Particles	9.1-9.5, 9.6-9.8			28		30			MAY
				5	]		[ =9=		
				=11=12=13=14=]					
(Ch 1) Matrices, Vectors, and Vector Calculus (sprinkled throughout)									Final Exam
*time-permitting									

We may try to arrange a 4<sup>th</sup> hour,  
if there is sufficient interest, staffing,  
and a mutually agreeable meeting time.

Some advice:

Physics is a **challenging** subject that requires your dedicated attention, but rewards you with skills that you can apply in **any** discipline!

Physics is **cumulative**: For example, understanding Ch 6 requires that you understand many of the chapters before it.

*You must not fall behind! If you find yourself falling behind, you must get some help.*

Physics is written and spoken in a **Mathematical** language.

Algebra, Trig, Geometry, Pre-Calculus, Calculus, Differential Equations, etc...are important. *Review mathematics NOW!*

Physics is about "understanding **relationships** between physical quantities", which we uncover by experiment and by mathematical reasoning.

Physics is **NOT about formulas** and merely plugging-in numbers.

Formulas are often only "special cases of expressions of those relationships".

*"Knowing a formula without knowing when it applies" is generally useless.*

The act of "plugging-in numbers" measures your ability to do Arithmetic or to use a calculator.

The resulting number is only useful when you **interpret it physically**. *"The right number with the wrong physics" is just plain wrong.*

**YOU CAN** understand and succeed in Physics only if YOU put in the required work.

Just attending lectures and labs is not enough. Just taking good notes is not enough.

Just reading the textbook is not enough. Just memorizing formulas and definitions is not enough.

Just doing the homework is not enough. Just reading the solutions is not enough.

There are no shortcuts. **YOU HAVE TO DO IT ALL.**