PHY 711 Classical Mechanics and Mathematical Methods
10-10:50 AM MWF Olin 103

Plan for Lecture 1:

1. **Welcome & overview**
2. **Class structure & announcements**
3. **Introduction to algebraic manipulation software – Maple and Mathematica**

➢ **Start reading Chap. 1 for next time**

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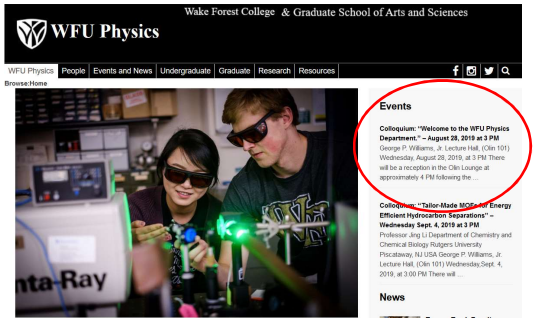
Comment about Physics Colloquia

http://www.physics.wfu.edu



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Colloquium: "Welcome to the WFU Physics Department." – August 28, 2019 at 3 PM

Posted on August 8, 2019
George P. Williams, Jr. Lecture Hall, (Olin 101)
Wednesday, August 28, 2019, at 3 PM

There will be a reception in the Olin Lounge at approximately 4 PM following the colloquium. All interested persons are cordially invited to attend.

PROGRAM

The purpose of this first seminar is to help new, returning, and prospective students (including both undergraduate and graduate students), faculty, and staff to become acquainted with each other and with the Physics Department. We will meet in the George P. Williams, Jr. Lecture Hall (Olin 101) at 3:00 PM for presentations by some undergraduate students highlighting their summer research experiences, followed by general welcoming statements and departmental announcements.

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Course schedule and office hours

Fall 2019 Schedule
for N. A. W. Holzwarth

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:00	Lecture Preparation/ Office Hours	Physics Research	Lecture Preparation/ Office Hours	Physics Research	Lecture Preparation/ Office Hours
10:00-11:00	Classical Mechanics PHY711		Classical Mechanics PHY711		Classical Mechanics PHY711
11:00-12:00	Office Hours		Condensed Matter Theory Journal Club		Office Hours
12:00-3:00	Physics Research		Physics Research		Physics Research
3:00-5:00			Physics Colloquium		

Please feel free to email me natalie@wfu.edu to set up an appointment outside of "official" office hours.
Office: Olin 300 Office Phone: 336-758-5510

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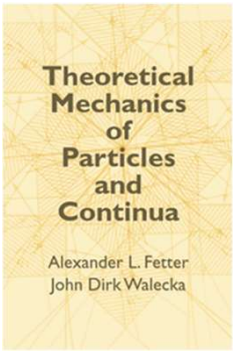
Textbook:



SIGNIFICANT NAMES IN MECHANICS AND MATHEMATICAL PHYSICS'

Isaac Newton (1642–1727)
Daniel Bernoulli (1700–1782)
Leonhard Euler (1707–1783)
Jean Le Rond d'Alembert (1717–1783)
Joseph Louis Lagrange (1736–1813)
Pierre Simon de Laplace (1749–1827)
Adrien Marie Legendre (1752–1833)
Jean Baptiste Joseph Fourier (1768–1830)
Karl Friedrich Gauss (1777–1855)
Siméon-Denis Poisson (1781–1840)
Friedrich Wilhelm Bessel (1784–1846)
Augustin-Louis Cauchy (1789–1857)
George Green (1793–1841)
Carl Gustav Jacob Jacobi (1804–1851)
William Rowan Hamilton (1805–1865)
Joseph Liouville (1809–1882)
George Gabriel Stokes (1819–1903)
Hermann Ludwig Ferdinand Helmholtz (1821–1894)
Gustav Robert Kirchhoff (1824–1887)
William Thomson (Lord Kelvin) (1824–1907)
Georg Friedrich Bernhard Riemann (1826–1866)
John William Strutt (Lord Rayleigh) (1842–1919)

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Comment – **Classical Mechanics is not Dead!**

While the topic of classical mechanics was well established by 1920, it forms the foundation of modern investigations and its extensions can be found in many current research areas.

Examples:

1. Atomistic simulations of materials – "molecular dynamics"
2. Scattering theory/experiments
3. Rocket science
4. Limiting results of quantum mechanics

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Topics

Classical Mechanics

- Scattering theory
- Accelerated reference frames
- Calculus of variation
- Lagrangian formalism
- Hamiltonian formalism
- Oscillations about equilibrium
- Wave equations
- Rigid rotation; moments of inertia
- Physics of fluids
- Sound waves in fluids and solids
- Surface waves
- Heat conduction
- Viscous fluids
- Elastic continua

Math Methods

- Use of Maple and/or Mathematica
- Solutions methods for differential equations
- Green's function methods
- Special functions
- Matrix properties; eigenvalues and eigenvectors
- Fourier transforms
- Laplace transforms
- Contour integration

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Course webpage https://users.wfu.edu/natalie/f19phy711

PHY 711 Classical Mechanics and Mathematical Methods

MWF 10 AM-10:50 AM | **OPL 103** | **http://www.wfu.edu/~natalie/f19phy711/**

Instructor: Natalie Holzwarth | **Phone:**758-5510 | **Office:**300 OPL | **e-mail:**natalie@wfu.edu

- General information
- Syllabus and homework assignments
- Lecture Notes

Last modfied: Wednesday, 21-Aug-2019 11:14:51 EDT

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General Information

This course is a one semester survey of Classical Mechanics and Mathematical Methods at the graduate level, using the textbook: **Theoretical Mechanics of Particles and Continua** by Alexander L. Fetter and John Dirk Walecka (McGraw-Hill, 1980) (now published by Dover) -- **F&W**.

It is likely that your grade for the course will depend upon the following factors:

Problem sets*	40%
Computational project	20%
Exams	40%

*In general, there will a new assignment after each lecture, so that for optimal learning, it would be best to complete each assignment before the next scheduled lecture. According to the honor system, all work submitted for grading purposes should represent the student's own best efforts.

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Course webpage: http://www.wfu.edu/~natalie/f19phy711

Computational Project

The purpose of this assignment is to provide an opportunity for you to study a topic of your choice in greater depth. The general guideline for your choice of project is that it should have something to do with classical mechanics, and there should be some degree of computation associated with the project. The completed project will include a short write-up and a ~20min presentation to the class. You may design your own project or use one of the following list (which will be updated throughout the term).

- Consider a scattering experiment in which you specify the spherically symetric interaction potential V(r). Write a computer program (using your favorite language) to evaluate the scattering cross section for your system. (Depending on your choice, you may wish to present your results either in the the center-of-mass or lab frames of reference.)
- Consider the Foucoult Pendulum. Analyze the equations of motion including both the horizontal and vertical motions. You can either solve the equations exactly or use perturbation theory. Compare the effects of the vertical motion to the effects of air friction.
- Consider a model system of 2 or more interacting particles with appropriate initial conditions, using numerical methods to find out how the system evolves in time and space. For few particles and special initial conditions this approach can be used to explore orbital mechanics. For many particles and random initial conditions, this approach can be used to explore statistical mechanics via molecular dynamics simulations.
- Examine the normal modes of vibration for a model system with 3 or more masses in 2 or 3 dimensions.
- Analyze the soliton equations beyond what was covered in class.

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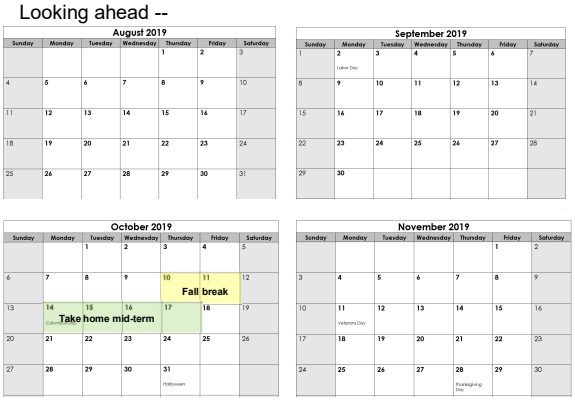
Looking ahead --



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Course webpage:
http://www.wfu.edu/~natalie/f19phy711/homework

Course schedule

(Preliminary schedule -- subject to frequent adjustment.)

	Date	F&W Reading	Topic	Assignment	Due
1	Mon, 8/26/2019	Chap. 1	Introduction	#1	8/30/2019
2	Wed, 8/28/2019	Chap. 1	Scattering theory		
3	Fri, 8/30/2019	Chap. 1	Scattering theory		
4	Mon, 9/02/2019	Chap. 1	Scattering theory		
5	Wed, 9/04/2019	Chap. 1	Scattering theory		
6	Fri, 9/06/2019	Chap. 2	Non-inertial coordinate systems		
7	Mon, 9/9/2019	Chap. 3	Calculus of Variation		
8	Wed, 9/11/2019	Chap. 3	Calculus of Variation		

PHY 711 - Assignment #1

08/26/2019

1. Use maple or mathematica to plot the functions

$$f(x)=e^{-x^2} \quad \text{and} \quad h(x)=\int_0^x f(t)\ dt.$$

and to numerically evaluate f(3) and h(3).

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Comment on software useful for this course

https://software.wfu.edu/

Installation straightforward; takes a while ..
Please contact me or yipcw@wfu.edu if you have trouble.

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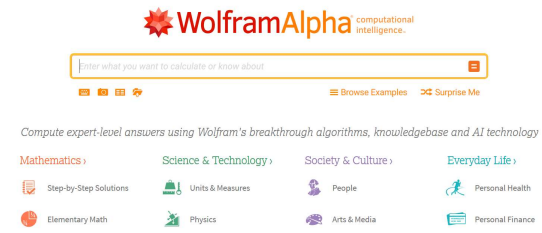
Other possibilities –
http://www.wolframalpha.com/



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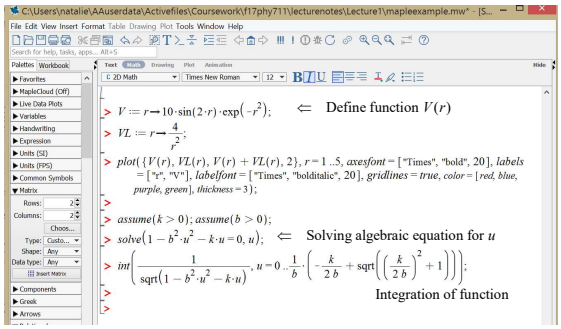
Example Maple file: mapleexample.mw



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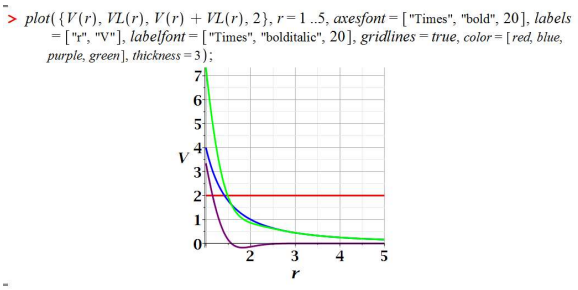
Maple exercise – continued:



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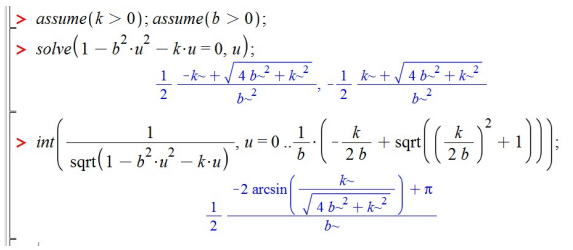
Maple exercise – continued:

Solving an algebraic equation and evaluating an integral:



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Brief assessment exercise.

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