PHY 711 Classical Mechanics and Mathematical Methods
9-9:50 AM MWF Olin 107

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**

Comment about Physics Colloquia

http://www.physics.wfu.edu

WFU Physics Colloquium

TITLE: "Welcome to the WFU Physics Department"

TIME: Wed. Aug. 30, 2017 at 3:30 PM*

PLACE: George P. Williams, Jr. Lecture Hall, (Olin 101)

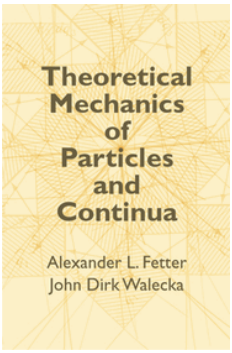
* Note: early starting time.

Refreshments will be served at 3:00 PM in the lounge. 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. After refreshments in the lounge in the lobby of Olin Physical Laboratory (starting at 3:00), we will meet in the George P. Williams, Jr. Lecture Hall (Olin 101) at 3:30 PM for some announcements followed by presentations by some undergraduate students, highlighting their summer research experiences.

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)

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

Fall 2017 Schedule
for N. A. W. Holzwarth

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:00	Classical Mechanics PHY711	Physics Research	Classical Mechanics PHY711	Physics Research	Classical Mechanics PHY711
10:00-12:00	Lecture Preparation/ Office Hours		Lecture Preparation/ Office Hours		Lecture Preparation/ Office Hours
12:00-1:00	Quantum Mechanics PHY741		Quantum Mechanics PHY741		Quantum Mechanics PHY741
1:00-2:15	Condensed Matter Theory Journal Club		Physics Research		Physics Research
2:15-3:30	Physics Research				
3:30-5:00			Physics Colloquium		

email: natalie@wfu.edu office: Olin 300

Course webpage: http://www.wfu.edu/~natalie/f17phy711

PHY 711 Classical Mechanics and Mathematical Methods

MWF 9 AM-9:50 AM | OPL 107 | http://www.wfu.edu/~natalie/f17phy711/

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

- General information
- Syllabus and homework assignments
- Lecture Notes

Last modified: Friday, 25-Aug-2017 23:20:53 EDT

Course webpage:
http://www.wfu.edu/~natalie/f17phy711

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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 the next scheduled lecture. According to the honor system, all work submitted for grading purposes should represent the student's own best efforts.

Course webpage: http://www.wfu.edu/~natalie/f17phy711

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 3 or more interacting particles with appropriate initial conditions, using numerical methods to find out how the system evolves in time and space.
- 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.

Course webpage: http://www.wfu.edu/~natalie/f17phy711/homework

PHY 711 Classical Mechanics and Mathematical Methods

MWF 9 AM-9:50 AM | OPL 107 | http://www.wfu.edu/~natalie/f17phy711/

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

Course schedule

(Preliminary schedule -- subject to frequent adjustment.)

	Date	F&W Reading	Topic	Assignment	Due
1	Mon, 8/28/2017	Chap. 1	Introduction	#1	9/6/2017
2	Wed, 8/30/2017	Chap. 1	Scattering theory	#2	9/6/2017
3	Fri, 9/01/2017				
4	Mon, 9/04/2017				
5	Wed, 9/06/2017				

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.

Course webpage:
http://www.wfu.edu/~natalie/f17phy711/homework

PHY 711 - Assignment #1

PDF VERSION

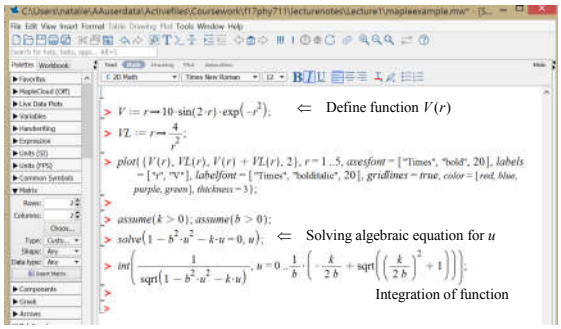
08/28/2017

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(5) and h(5).

Example Maple file: mapleexample.mw



$> V := r \mapsto 10 \cdot \sin(2 \cdot r) \cdot \exp(-r^2);$ ⇐ Define function $V(r)$

$> VL := r \mapsto \frac{4}{r^2};$

$> plot([V(r), VL(r), V(r) + VL(r), 2], r = 1..5, axesfont = ["Times", "bold", 20], labels = ["r", "V"], labelfont = ["Times", "bolditalic", 20], gridlines = true, color = [red, blue, purple, green], thickness = 3);$

$> assume(k > 0); assume(b > 0);$

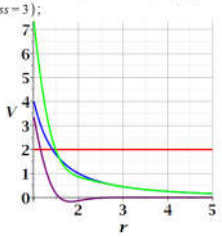
$> solve(1 - b^2 \cdot u^2 - k \cdot u = 0, u);$ ⇐ Solving algebraic equation for u

$> int\left(\frac{1}{\text{sqrt}(1 - b^2 \cdot u^2 - k \cdot u)}, u = 0 .. \frac{1}{b} \cdot \left(-\frac{k}{2\,b} + \text{sqrt}\left(\left(\frac{k}{2\,b}\right)^2 + 1\right)\right)\right);$

Integration of function

Maple exercise – continued:

$> plot([V(r), VL(r), V(r) + VL(r), 2], r = 1..5, axesfont = ["Times", "bold", 20], labels = ["r", "V"], labelfont = ["Times", "bolditalic", 20], gridlines = true, color = [red, blue, purple, green], thickness = 3);$



Maple exercise – continued:

Solving an algebraic equation and evaluating an integral:

$> assume(k > 0); assume(b > 0);$

$> solve(1 - b^2 \cdot u^2 - k \cdot u = 0, u);$

$$\frac{1}{2}\,\frac{-k\sim + \sqrt{4\,b\sim^2 + k\sim^2}}{b\sim^2}, -\frac{1}{2}\,\frac{k\sim + \sqrt{4\,b\sim^2 + k\sim^2}}{b\sim^2}$$

$> int\left(\frac{1}{\text{sqrt}(1 - b^2 \cdot u^2 - k \cdot u)}, u = 0 .. \frac{1}{b} \cdot \left(-\frac{k}{2\,b} + \text{sqrt}\left(\left(\frac{k}{2\,b}\right)^2 + 1\right)\right)\right);$

$$\frac{1}{2}\,\frac{-2\arcsin\left(\frac{k\sim}{\sqrt{4\,b\sim^2 + k\sim^2}}\right) + \pi}{b\sim}$$

Brief assessment exercise.