Physics 2820: Computational Mechanics. Fall 2019

Course website: http://online.mun.ca

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Synopsis:

The use of computers pervades all fields of science.

Phys 2820 introduces the student to the world of computational physics. From plotting functions and finding roots of algebraic equations, to solving a differential equation, to carrying out operations on sets of data to find relationships between measured variables, the skills learned will be useful anywhere computers are used to solve problems.

In order to make use of a computer, one must be able to precisely translate the method of solving the problem into instructions that the computer can blindly follow. Thus, students will gain hands-on experience in programming (in Python). The students will learn some of the numerical techniques used to differentiate and integrate functions and to solve ordinary differential equations, and gain an appreciation of the limits of numerical solutions.

The context of computation will be primarily classical mechanics, include projectile motion, N-body problems, oscillations, normal modes, as well as examples from geophysics such as gravitational prospecting and determining travel times of seismic waves.

Lectures:

Tuesday and Thursday. Slot 19. 2:00 – 3:15. C-2039

Phys 2820 will be taught in a hybrid format for Fall 2019. The class will regularly meet in C-2039 but most of the lectures will also be delivered over the Internet using video conferencing. Lectures delivered over video conferencing may be attended remotely. See the schedule below for details on the lecture format.

Labs:

Section 001	Tuesday 3:30-5:00 pm	C-2039
Section 002	Thursday 3:30-5:00 pm	C-2039

Laboratories (7 in total) form a component of the course. Notwithstanding which section for the course you are registered, you may attend either lab session as needed. If you anticipate missing both lab slots on a particular week, please contact Dr. Munroe via email.

Jupyter notebooks from labs will be collected electronically at the end of the Thursday lab sessions.

Software:

The programming language used in this course will be Python 3. A webserver with the required software has been set up for you to use during this course:

https://tinyurl.com/phys2820-F2019

Your user id is the same as your MUN id. e.g. if your email is xyz123@mun.ca then your user id is xyz123. Choose a new password the first time you log on; this sets the password on the server.

This server will be taken down at the end of the course. If you want to use Python and Jupyter for future course work, the Anaconda distribution of Python is recommended.

Textbook:

An Introduction to Computer Simulation Methods 3rd Ed. Gould, Tobochnik, and Christian. (PDF copies of the chapters are available from ComPADRE)

Assignments (7 in total):

To be collected electronically at 10:00 pm on the due date

Evaluation:

Assignments	20%
Laboratories	20%
Mid-term tests	20%
Final Exam	40%

There is no supplementary exam.

Mid-term tests (in-class, C2039):

Midterm Test I	Tuesday, October 8
Midterm Test II	Tuesday, November 12

Missed work:

Students who cannot complete assignments, labs, or mid-term tests need to consult the University Calendar, Section 6.7.5 Exemptions from Parts of the Evaluation, and email Dr. Munroe.

Important general information from the University.

It is the student's responsibility to acquaint themselves with these items. Please read.

3. Student Code of Conduct. http://www.mun.ca/student/conduct/

6.8.2 Exemptions From Final Examinations http://www.mun.ca/regoff/calendar/sectionNo=REGS-0628

6.12 Academic Misconduct http://www.mun.ca/regoff/calendar/sectionNo=REGS-0748

Accommodations for Students with Disabilities http://www.mun.ca/blundon/accommodations/

Tentative Schedule

Date	**Format**	**Lecture topic**	**Note**
Thu, Sep 5	C2039	1. Computer Simulations in Physics	
Tue, Sep 10	C2039	2. Python Programming	
Thu, Sep 12	Video	3. The Effect of Air Resistance	
Tue, Sep 17	Video	4. The Trajectory of a Cannon Shell	Lab 1
Thu, Sep 19	Video	5. Sports Balls and the Effects of Spin	Lab 1
Sun, Sep 22			Assignment 1 due
Tue, Sep 24	Video	6. Simple Harmonic Motion	Lab 2
Thu, Sep 26	Video	7. Damped Pendulums	Lab 2
Sun, Sep 29			Assignment 2 due
Tue, Oct 1	Video	8. Forced Pendulums	Lab 3
Thu, Oct 3	C2039	9. Lorenz Model and the Butterfly Effect	Lab 3
Sun, Oct 6			Assignment 3 due
Tue, Oct 8	C2039	**Test 1**	
Thu, Oct 10	Video	10. Data Analysis and Curve Fitting	
Tue, Oct 15			Fall semester break
Thu, Oct 17	Video	11. Taylor series and Error Estimation	
Tue, Oct 22	Video	12. Numerical Differentiation and Integration	Lab 4
Thu, Oct 24	Video	13.Higher-Order Methods for Solving DEs	Lab 4
Sun, Oct 27			Assignment 4 due
Tue, Oct 29	Video	14. Travel Time of Seismic Waves	Lab 5
Thu, Oct 31	Video	15. Wave Motion	Lab 5
Sun, Nov 3			Assignment 5 due
Tue, Nov 5	Video	16. Computer Algebra Systems	Lab 6
Thu, Nov 7	C2039	17. Building on Physics Past	Lab 6
Sun, Nov 10			Assignment 6 due
Tue, Nov 12	C2039	**Test 2**	
Thu, Nov 14	Video	18. Celestial Mechanics	
Tue, Nov 19	Video	19. Precession of the Perihelion of Mercury	Lab 7
Thu, Nov 21	Video	20. Three-Body Problem	Lab 7
Sun, Nov 24			Assignment 7 due
Tue, Nov 26	Video	21. Molecular Dynamics	
Thu, Nov 28	Video	22. Course Review	