# PHYS 239: WINTER 2013

University of Waterloo

**Term and Year of Offering:** Winter 2013

**Course Number and Title:** PHYS 239 - Scientific Computation 2

**Lecture Times, Building and Room Number:** T, Th 10-11:20 PHY 235

**Instructor’s Name, Office Location, Office Hours, Contact:**

Mike Hudson, PHY 252, 3:30 to 4:30 Wed, [mihudson@uwaterloo.ca](mailto:mihudson@uwaterloo.ca) ext. 32212.

Outside of office hours, you can try your luck by popping by my office. But first check my schedule - if it says "Busy" I am almost certainly not in my office.

**TA's Name, Contact:**

Catherine Holloway [c2hollow@uwaterloo.ca](mailto:c2hollow@uwaterloo.ca)

**Course Description:**

“Numerical analysis in electrostatics, mechanics and quantum mechanics with emphasis on finite difference and finite element solution methods.”

**Course Objectives:** At the end of the course you should be able to:

- Use numerical methods to solve systems of differential equations, and apply these solutions to physical problems. Understand shortcomings of such techniques.
- Perform advanced data analysis and regression, including plotting.
- Perform Monte Carlo simulations of physical systems.
- Use advanced programming techniques, particularly object-oriented programming.

**Text:**


Other textbooks:

- A Primer on Scientific Programming with Python, 2nd ed H. P. Langtangen, Springer 201

**Topics to be Covered in Lectures:**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time</th>
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<tbody>
<tr>
<td>Intro to Advanced Computational Techniques in Science</td>
<td>0.5 week</td>
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</table>
Python, NumPy, Scipy and matplotlib (visualization) 1.5 weeks
Object Oriented Programming 1 week
Solving Ordinary Differential Equations, Simulations 2 weeks
Nonlinear Dynamics, Chaos, Fractals 1 week
Time Series, Fourier Transforms and Image Processing 1.5 weeks
Data Analysis, Statistics, Model Fitting, Maximum Likelihood 1.5 weeks
Thermodynamics, Entropy and Monte Carlo and Molecular Dynamics Simulations 2 weeks
Advanced Programming Techniques (libraries, parallel, mixing Python with C, etc.) 1 week

**Evaluation:**

<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>In-class (participation, quizzes, exercises)</td>
<td>5%</td>
</tr>
<tr>
<td>Assignments</td>
<td>35%</td>
</tr>
<tr>
<td>Project</td>
<td>20%</td>
</tr>
<tr>
<td>Tests</td>
<td>40%</td>
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</tbody>
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**Mid-term (15%) will be during class time.** Date TBA but at least 3 weeks in advance. **Final exam (25%) will be scheduled by Registrar.**

**Rules for Group Work in Assignments:** Students cannot work in pairs or groups. Your programs must be entirely your own work.

**Plagiarism detection** software will be used to screen assignments and tests in this course.

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**Academic Integrity, Grievance, Discipline, Appeals and Note for Students with Disabilities:**

See [www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf](https://www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf) The text for this web site is listed below:

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check [www.uwaterloo.ca/academicintegrity/](https://www.uwaterloo.ca/academicintegrity/) for more information.]

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](https://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please be certain to contact the department’s administrative assistant who will provide further assistance.

**Discipline:** A student is expected to know what constitutes academic integrity [check [www.uwaterloo.ca/academicintegrity/](https://www.uwaterloo.ca/academicintegrity/)] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](https://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties check Guidelines for the Assessment of Penalties, [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](https://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm).
**Appeals:** A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm).

**Note for Students with Disabilities:** The Office for persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.