PH4390 - Computational Methods In Physics
College of Science and Arts
Fall 2011

Instructor Information

Instructor : Gowtham  
Office Location : EERC B39  
E-mail : sgowtham@mtu.edu  
Office Hours : Tuesday, 2:00 - 3:00 pm or by appointment

Course Information

Course #/Name : PH4390/Computational Methods in Physics  
Class Location : Fisher 231  
Class Times : WF, 3:05 - 3:55 pm  
Course Website : http://phy.mtu.edu/~sgowtham/PH4390/  
Twitter : http://twitter.com/fizicist/

Course Overview & Objectives

† Gain a first hand experience of the use and limitations of computers for solving problems in physical sciences

† Translate problems in physical sciences into computer code/program [C, C++, FORTRAN 90, Java, Mathematica, MATLAB, PERL, Python, etc.] to be solved using computational routines/resources

† Acquire/Enhance good coding/programming etiquette and an understanding of the sources of errors in such programs
Course Text Book

Numerical Recipes - The Art of Scientific Computing, 3/e
William Press, Saul Teukolsky, William Vetterling & Brian Flannery
Cambridge University Press (2007)
ISBN: 978-0521880688

Grading Policy

60% Programming Assignments + 30% Final Project + 10% Project Report

General Guidelines

† Show up on time

† Assignments will be due two weeks from when they are handed out. Late submissions will not be accepted

† There are no restrictions on programming languages - you can use one [or more] that you are most comfortable with

† When an assignment involves code, please make sure that the code is well commented and that you have used meaningful nomenclature for variables & data structures

† Assignments should be submitted electronically (via email attachments - *.tex, *.bib, *.pdf, *.m, *.c, *.f, etc.) so that I can test them out on my computer

† It is OK to seek help from your classmates and/or elsewhere but any such help must be clearly and appropriately cited in the assignment

† Electronic devices such as cell/smart phone, iPod, PDA, etc. are not to be used in the classroom. Please make sure to bring a calculator with you to the class. Information exchanges using electronic devices during class are also prohibited and violate the Academic Integrity Code of Michigan Tech
University Policies

Academic regulations and procedures are governed by University Policy. Academic dishonesty cases will be handled in accordance the University’s policies.

If you have a disability that could affect your performance in this class or that requires an accommodation under the Americans with Disabilities Act, please see me as soon as possible so that we can make appropriate arrangements. The Affirmative Action Office has asked that you be made aware of the following:

Michigan Tech complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act of 1990. If you have a disability and need a reasonable accommodation for equal access to education or services at Michigan Tech, please call the Dean of Students Office, at (906) 487-2212. For other concerns about discrimination, you may contact your adviser, department head or the Affirmative Action Office, at (906) 487-3310.

Academic Integrity:
http://www.studentaffairs.mtu.edu/dean/judicial/policies/academic_integrity.html

Affirmative Action:
http://www.admin.mtu.edu/aaoo/

Disability Services:
http://www.admin.mtu.edu/urel/studenthandbook/student_services.html#disability

Equal Opportunity Statement:
Tentative Schedule

Week 01
Keeping Things Organized
- Backup
- GNU Make
- Version control
- Programming etiquette

Week 02
Paper n’ Pencil
- Dimensional analysis
- Analytical solutions
- Need for computational methods

Week 03 – 04
Program Compilation 101
Sources of Errors
- Approximation errors
- Logical/Design errors
- Range & Round-off errors
- Compiler errors
- Run time errors

Week 05 – 06
Finding Roots
- Successive bisection method
- Newton-Raphson method
- Hybrid method
- False position & Secant methods
- Finite square well in quantum mechanics

Week 07
First Order Differential Equations
- Euler’s method
- Runge-Kutta method
Motion along a straight line
Radioactive decay

Week 08
Second Order Differential Equations
- Runge-Kutta method
Shooting hoops and playing quarterback
Bike ride
Simple & double pendulum

Week 09
*Houston, we’ve had a problem*
- Project statement
- Solution approach
- Hurdles/Obstacles
- Modularized coding
- Testing, analysis & summary
- Status report due every week

Week 10 – 12
Numerical Integration
- Trapezoid rule
- Simpson’s rule
- Simpson’s 3/8th rule
- Monte Carlo method
Parallel Computing & Programming 101

Week 12 –13
GPU Computing 101
- Fourier Series
- Fourier Transform
- Monte Carlo method revisited

Week 13
*Thanksgiving Break*

Week 14 – 15
Advanced Programming Topics
Project & Final Report Due

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1Dr. Steven Seidel
2Dr. Allan Struthers