Michigan Technological University

PH4390 Computational Methods in Physics

Syllabus

Fall 2017

Instructor Information

Instructor:	Kevin Waters
Office Location:	Fisher 227A
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Office Hours:	T/TH 11:00 - 12:00 or by appointment

Instructor:	Ravindra Pandey
Office Location:	Fisher 108
Office Hours:	by appointment

Course Identification

Course Number:	PH4390
Course Name:	Computational Methods in Physics
Course Location:	T/TH Fisher 132, F Rehki 117
Class Times:	T/TH 10:05am - 10:55am, F 9:05am - 10:55am
Prerequisites:	PH 2020 Introduction to Scientific Programming and Error Analysis PH 3410 Quantum Physics I

Course Description/Overview

An overview of numerical and computational methods to analyze and visualize physics problems in mechanics, electromagnetism, and quantum mechanics. Utility and potential pitfalls of these methods, basic concepts of programming, UNIX computing environment, and system libraries.

Learning Objectives

† Gain an understanding of the basics of writing and executing useful code.

† Learn the fundamentals of the Unix/Linux environment.

† Author software that allows the student to solve physical problems.

† Write reports using theory and numerically generated data to analyze and solve complex problems.

Course Resources

† Canvas: https://mtu.instructure.com/

† Required Text: No required text for this course.

Grading Scheme

Total Points

Assignments = 10 x 10 Points each = 100 Points
Project = 30 Points
Total = 130 Points

Grading System

Grade	Percentage	Points
A	93% - 100%	121-130
AB	87% - 92%	113-120
B	82% - 86%	106-112
BC	76% - 81%	99-105
C	70% - 75%	91-98
CD	65% - 69%	84-90
D	60% - 64%	78-83
F	59% - 0%	0-77

Grading Rubric for Assignments

Section	Breakdown	Points	Description
Code	Compiles	1	Code compiles successfully.
	Documentation	1	Code is commented and clear.
	Readme	1	Readme describes compilation and run procedure.
	Functionality	1	Code produces a reasonable solution.
Report	Discussion	1	Approximations used are discussed, description of theory.
	Equations	1	Equations are provided and descriptions provided.
	Data Presentation	1	Data has descriptions and is labeled with units.
	Report Clarity	1	Report is organized and clear.
	Questions	2	Questions are answered correctly with an explanation.
	Total	**10**	

Grading Rubric for Project

Section	Breakdown	Points	Description
Code	Compiles	2	Code compiles successfully.
	Documentation	2	Code is commented and clear.
	Readme	2	Readme describes compilation and run procedure.
	Functionality	2	Code produces a reasonable solution.
Report	Discussion	2	Approximations used are discussed, description of theory.
	Equations	2	Equations are provided and descriptions provided.
	Data Presentation	2	Data has descriptions and is labeled with units.
	Report Clarity	2	Report is organized and clear.
	Questions	4	Questions are answered correctly with an explanation
Presentation		10	
	Total	**30**	

Late Assignment Policy

No late assignments will be accepted, if problems arise please contact the instructor.

Collaboration/Plagiarism Rules

Collaboration is encouraged in this course, however, work will be turned in independently and cited properly. At the end of each assignment use the references section to cite all books, web resources, student collaborations, and any other outside source you make have used.

University Policies

For more information about reasonable accommodation for equal access to education or services at Michigan Tech, please call the Dean of Students Office, at (906) 487- 2212 or go to http://www.mtu.edu/ctl/instructional-resources/syllabus/syllabus_policies.html

Course Schedule

Week	Date	Day	Type	Description
Week 1	9/5	T	Lecture	Introduction and Syllabus Review
	9/7	Th	Lecture	The C Programming Language
	9/8	F	**No Class**	K-Day
Week 2	9/12	T	Lecture	Types, Operators, Expressions
	9/14	Th	Lecture	Functions and Structures
	9/15	F	Lab	Assignment 1: Error Analysis
Week 3	9/19	T	Lecture	Convergence, Precision, Accuracy
	9/21	Th	Lecture	Plotting Data (gnuplot)
	9/22	F	**No Class**	Assignment 2: Plotting Data and Errors
				Assignment 1: Due by 8:59am
Week 4	9/26	T	Lecture	Modular Programming: Divide and Conquer
	9/28	Th	Lecture	Makefiles: Compiling with Ease
	9/29	F	Lab	Assignment 3: Series and Truncations
				Assignment 2: Due by 8:59am
Week 5	10/3	T	Lecture	Random Numbers
	10/5	Th	Lecture	Monte Carlo Methods
	10/6	F	Lab	Assignment 4: π at Monte Carlo
				Assignment 3: Due by 8:59am
Week 6	10/10	T	Lecture	Roots: Successive Bisection Method
	10/12	Th	Lecture	Roots: Newtown-Raphson & Hybrid
	10/13	F	Lab	Assignment 5: Finding Roots
				Assignment 4: Due by 8:59am
Week 7	10/17	T	Lecture	Integration: Simpson's/Trapezoid Rule
	10/19	Th	Lecture	GSL Libraries
	10/20	F	Lab	Assignment 6: Electrons and Wavefunctions
				Assignment 5: Due by 8:59am
Week 8	10/24	T	Lecture	Differential Equations: Euler
	10/26	Th	Lecture	Differential Equations: RK4
	10/27	F	Lab	Assignment 7: Projectile Motion
				Assignment 6: Due by 8:59am

Week 9	10/31	T	Lecture	Matrices: Computational Linear Algebra
	11/2	Th	Lecture	Matrices: Libraries
	11/3	F	Lab	Assignment 8: 2-D Drag
				Assignment 7: Due by 8:59am
Week 10	11/7	T	Lecture	Unit Tests: Checking with Ease
	11/9	Th	Lecture	Unit Tests: Part Two
	11/10	F	Lab	Assignment 9: Unit Test Generation
				Assignment 8: Due by 8:59am
Week 11	11/14	T	Lecture	Final Project Overview Part I
	11/16	Th	Lecture	Final Project Overview Part II
	11/17	F	**No Class**	
				Assignment 9: Due by 8:59am
Week 13	11/21	T	**No Class**	Thanksgiving Break
	11/23	Th	**No Class**	Thanksgiving Break
	11/24	F	**No Class**	Thanksgiving Break
Week 12	11/28	T	Lecture	TBD
	11/30	Th	Lecture	TBD
	12/1	F	Lab	Make-Up Session
				Project Update: Due by 8:59am
Week 14	12/5	T	Lecture	TBD
	12/7	Th	Lecture	TBD
	12/8	F	Lab	Final Project I
Week 15	12/12	T	Lecture	Optional: Project Questions
	12/14	Th	Lecture	Optional: Project Questions
	12/15	F	Lab	Final Project II
Week 16	12/19	T	Final Exam	Final Project Presentations