ANDERSON UNIVERSITY

Computational Physics

PHYS 4220

Instructor Info

Name: Tyler Williamson

Office Hours: M T W: 3-5pm, W F: 12-1 pm

Office: Hartung 315A

Email: tjwilliamson@anderson.edu

Course Info

Prereq: PHYS 3130, MATH 3020

Meeting Days: M W F

Meeting Times: 2pm-2:50pm

Location: Hartung 316

Overview

In this course, you will learn to use computational methods to solve complex physical problems which are difficult or impossible to solve analytically. In the process, you will develop a deeper understanding of the physics principles developed in other courses. Topics include classical dynamics, electrostatics, statistical mechanics, quantum mechanics and more.

Note: This is an entirely in-person course, although material will be replicated online to accommodate ill or quarantined students.

Material

Required Texts

Giordano, N.J. and Nakanishi, H. *Computational Physics*. 2nd Edition. Pearson Education. 2005

Required Software

Python3

Grading Scheme

Homework	40%
Projects (x4*)	60%

$grade \geq 93$	A	$73 \leq grade < 77$	C
$90 \leq grade < 93$	A-	$70 \leq grade < 73$	C-
$87 \leq grade < 90$	B+	$67 \leq grade < 70$	D+
$83 \leq grade < 87$	B	$63 \leq grade < 67$	D
$80 \leq grade < 83$	B-	$60 \leq grade < 63$	D-
$77 \leq grade < 80$	C+	$grade < 60$	F

Note: As the instructor, I reserve the right to change the grade of any student, but only to that student's benefit and only under exceptional circumstances.

* *May be fewer but will not be more*

Learning Objectives

- Learn how to use physics principles to approach complex problems
- Learn to approximate the effects of "real world" complications on traditional physics problems (friction, damping, etc.)
- Gain a deeper understanding of the physics principles developed in other courses
- Become familiar with numerical methods and new areas of physics that can be studied using them

Course Requirements

Homework

Homework is designed to help you practice what you are learning in class. Homework will be assigned in class and will be submitted on Canvas.

Projects

In lieu of exams, projects are designed to test your ability to apply the methods learned in class to more complex problems. Projects will be assigned in class and submitted on Canvas.

COVID-19 Statement

As a member of the AU community, we acknowledge our covenant to protect and care for each other by embracing the following measures in this class: wearing a facial covering, maintaining 6' physical distance from others, practicing good respiratory hygiene, and using hand hygiene.

Due to the unpredictable nature of the COVID-19 pandemic, and factors that are out of control of the instructor, students should be prepared for a (possibly abrupt) pivot in instruction mode. In that situation, learning objectives for the course will remain the same, however the instructor reserves the right to modify due dates as well as the number and frequency of assignments, quizzes, and exams. Any such changes will be communicated via AU email and Canvas.

During this coronavirus pandemic, the AU faculty and staff are making every effort to provide the best possible environment for face-to-face (F2F) instruction, as well as the best online environment, if we are forced to transition online. We encourage you to follow the community covenant, both on campus and off campus, in your educational environments as well as in your social environments. These guidelines are intended to maximize the amount of F2F instruction, by reducing the transmission rate of the coronavirus on campus and in the surrounding community. **As such, all Physical Sciences and Engineering department classes taught in face-to-face format will require properly worn facial coverings, 6' physical distancing, and good respiratory and hand hygiene**. Note that accommodations will be made for cases approved by the University for those students who cannot wear a facial covering for health reasons.

The department faculty will facilitate learning in this pandemic environment through the use of tools such as email, Canvas (learning management system), Kaltura (recording F2F lectures and labs), and/or other educational tools. These tools allow for flexible learning, in the cases where students are unable to attend class in person, either through illness, quarantine, the need to care for family members, or other situations.

It is imperative that we work together to slow the spread, through the community care covenant. It is very important that we communicate clearly with each other, extending grace towards each other, and solving problems together. Please contact your professor and/or the chair of the Physical Sciences and Engineering department, Dr. Benjamin McPheron, with any concerns, and keep us up to date regarding any changes in your class attendance.

Attendance Policy

Class attendance is fundamental to the teaching/learning process and any absence from a class results in a loss of learning for the student and learning community. In the current pandemic environment, it is imperative that we balance our face-to-face learning with the risk posed by the coronavirus. For this reason, if you need to miss class for any reason (such as feeling a little under the weather), participation in the equivalent online activities will not count as an absence presuming, if applicable, any required assignments are completed. It is the student's obligation to personally notify the course instructor when not attending the class face-to-face, in advance if possible, and to complete the required assignments for that class session prior to the due date, or at a modified date at the discretion of the instructor. In the case of an extended illness or a mandated quarantine, notify the professor as soon as possible to discuss options for modified due dates or other accommodations.

Academic Integrity

As an institution of higher education committed to academic and Christian discovery, Anderson University expects faculty and students alike to maintain the highest standards of academic and personal integrity. "Anderson University seeks to support and promote qualities of academic honesty and personal integrity and regards cheating, plagiarism, and all other forms of academic dishonesty as serious offenses against the University community" (Faculty Handbook 4.23 Policy on Academic Integrity). See the student handbook for examples of plagiarism. When an instructor has additional definitions of academic dishonesty, they must be stated in the Syllabus at the beginning of the course.

You are expected to do your own work in this course. The work you turn in must be substantially your own. Any incidences of academic dishonesty will be handled according to University policy.

Academic Support

Accessibility and Accommodations

Important: If you have any special accessibility needs (i.e. use of screen reading software, captioning, etc.), please notify your professor and the Director of Disability Services for Students (Kissinger Academic Center for Excellence, Nicholson Library; 765-641-4223) as soon as possible. If you anticipate or experience physical or academic barriers based on disability, you are encouraged to contact the Director of Disability Services for Students (Kissinger Academic Center for Excellence, Nicholson Library; 765-641-4223). To receive reasonable accommodations, you must contact Disability Services for Students, provide documentation, and request accommodations. You should also notify your course instructor during the first week of classes.

Kissinger Academic Center for Excellence

The Kissinger Academic Center for Excellence (KACE), located on the ground floor of the Nicholson Library, provides excellent resources in all areas of study regardless of academic ability. Many students can benefit from academic support and/or sharpen their skills through studying with others. In addition, excellent students often maintain their skills by working as peer tutors. The services are available for all enrolled students at no charge. For information, call 765-641-4225.

Pathways Program

Anderson University has a robust referral system that was created to connect students with the campus resources that will be most beneficial to them. Students may be referred by faculty for any student success issue. Students will be contacted by an appropriate staff or faculty member to provide support and care. For more information please see: anderson.pharos360.com.

Diversity and Inclusivity Statement

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Class Schedule

Subject to change

Week 1	Intro to Python	
	Working with dimensionless equations	
	Euler's method for simple ODE's	Giordano, 1
Week 2	Error & stability analysis of Euler's method	
	Radioactive decay	Giordano, 1
	Drag forces and bicycle motion	Giordano, 2.1
Week 3	Projectile motion in the atmosphere	Giordano, 2.2-2.4
Week 4	The physical pendulum & chaos	Giordano, 3.1-3.3
Week 5	The physical pendulum & chaos	Giordano, 3.1-3.3
Week 6	Waves on a string	Giordano, 6
Week 7	Statistical mechanics and the Ising model	Giordano, 8
Week 8	Statistical mechanics and the Ising model	Giordano, 8
Week 9	Laplace's and Poisson's equations	Giordano, 5.1-5.2
Week 10	Magnetic fields	Giordano, 5.3-5.4
Week 11	Quantum mechanics: Time independent	Giordano, 10.1-10.4
Week 12	Quantum mechanics: Time dependent	Giordano, 10.5-10.6
Week 13	Thanksgiving Break	
Week 14	Orbital dynamics*	Giordano, 4
Week 15	Orbital dynamics*	Giordano, 4

* *Time permitting*