

# Phys 220: Introduction of Computational Physics

Spring 2024

# Instructor Information

Instructor Wang Xu (Caleb)

Email wxu3@alaska.edu Office Location & Hours REIC 110, TBD

# **General Information**

# **Course Description**

Physics 220 is a four-credit course. It serves as an introductory exploration of computational methods for tackling familiar physics problems. It could give us deeper insights into physical systems and their behaviors in different areas of physics than analytic methods. Students carry out their work primarily using the Phyton computing language. It is designed for undergraduate students who have some knowledge of introductory physics and calculus.

# Prerequisite

MATH F253; PHYS F211; PHYS F212; PHYS F213; or permission of instructor

## Lecture Schedule

Lectures: Lectures: REIC 165, Mondays, Wednesdays, and Fridays, 1 pm-2 pm Labs: Noyes Computer Lab (REIC 101), Thursdays, 8 am-11 am

# Course Goals:

- 1. Think critically about using the computer to understand the physical world.
- 2. Learn to create practical code from numerical algorithms.
- 3. Understand the simulation process through random walks.
- 4. Get familiar with data handling tools like basic data fitting.
- 5. Solve ordinary differential equations using computational methods.
- 6. Introduce numerical solutions for partial differential equations.

The course will have succeeded if you know the necessary tools to address problems in physics that cannot be solved analytically, and if you feel comfortable using these tools.

## **Textbook:**

The course curriculum is based on Computational Physics, 2nd Ed. by Giordano and Nakanishi. The book is not required but does provide useful additional information. However, it is Fortran based, and we will program in Python in this class.



## **Grading Policy**

Homework	Attendance	Quizzes	Project	Midterm	Final	Total
30%	10%	10%	15%	15%	20%	100%

Your final grade for this course will be based on a curve. The average value of the curve will be the breakpoint between letter grades B- and C+. The standard deviation of the grade point distribution will separate subsequent letter grades.

# Lecture Schedule

Week	Торіс	Reading	Dates	HWK Due Date
Week 1	Installation	Holidays,,Lab,	<del>01/15</del> ,01/17, <u>01/18</u> ,01/19	01/25
Week 2	Variables	,, Lab, Quiz 1	01/22,01/24, <u>01/25</u> ,01/26	02/01
Week 3	Graphing	,, Lab, Quiz 2	01/29,01/31, <u>02/01</u> ,02/02	02/08
Week 4	Numeric calculation	,, Lab, Quiz 3	02/05,02/07, <u>02/08</u> ,02/09	02/15
Week 5	Monte Carlo technique	,, Lab, Quiz 4	02/12,02/14, <u>02/15</u> ,02/16	02/22
Week 6	Monte Carlo simulation	,, Lab, Quiz 5	02/19,02/21, <u>02/22</u> ,02/23	02/29
Week 7	Fitting data	,, Lab, Quiz 6	02/26,02/28, <u>02/29</u> ,03/01	03/07
Week 8	Radioactive decay and Forward Euler	,, Lab, Midterm	03/04,03/06, <u>03/07</u> , <mark>03/08</mark>	03/21
Week 9		Spring Break	<del>03/11,03/09,03/14,<i>03/15</i></del>	
Week 10	Projectile of motion	,, Lab, Quiz 7	03/18,03/20, <u>03/21</u> , <u>03/22</u>	03/28
Week 11	Oscillatory motion	,, Lab, Quiz 8	03/25,03/27, <u>03/28</u> ,03/29	04/04
Week 12	Pendulum and Chaos	,, Lab, Mid-Project	04/01,04/03, <u>04/04</u> , <u>04/05</u>	04/11
Week 13	Planetary motion	,, Lab, Quiz 10	04/08,04/10, <u>04/11</u> ,04/12	04/18
Week 14	Partial Differential Equations	,, Lab, Quiz 11	04/15,04/17, <u>04/18</u> ,04/19	04/25
Week 15	Schrödinger Equation	,, Lab, Project	04/22,04/24, <u>04/25</u> , <b>04/26</b>	05/02*
Week 16	Reviews	, Final,	<del>04/29</del> , <u><b>05/01</b>,<del>05/02,05/03</del></u>	



## **Exam Schedule**

Dates	Subjects	
03/08	Mid-term	
03/22	Project-proposal	
04/05	Project- draft	
04/26	Project presentation	
05/1(TBD)	Final Exam	

# Additional Requirements & Policy

### Attendance:

You are expected to fully attend both the laboratory and lecture sessions. Planned absences should be discussed with me in advance. Habitual tardiness or absenteeism affects not only your own performance, but that of your classmates, too. Assessment will be based on your contributions to class discussions and laboratory investigations. You are expected to attend classes regularly.

### Homework:

On average, 3-4 problems will be assigned in the lab section on every <u>Wednesday</u>. The homework will be due before the class on following <u>Wednesday</u>, and you need to submit it on the canvas. NO LATE HOMEWORK WILL BE ACCEPTED—NO EXCEPTIONS (barring emergencies and extreme situations). Group work is encouraged to solve problems. Students are welcome to consult the instructor during office hours or by appointment for additional help with homework. All homework you submit should reflect your own work. Copying homework is absolutely unacceptable and will result in a grade of ZERO for the assignment.

### **Project:**

You will choose a computational physics problem of your own, develop and execute a solution. A written project proposal will be submitted not later than the quiz 7 session of March 22. You will submit a complete, written solution of the problem, to include working codes, prior to the beginning of the final scheduled lecture. You will give a 10-minute ppt presentation of your project to the class during the last lecture.

## **Quizzes:**

11 short quizzes will be given in class during the semester. They will be open-book quizzes, and calculators will be allowed. The quiz material given will be similar to the recent homework or topics covered in class. All necessary formulas will be provided.

#### Exams:

There will be one midterms and a final comprehensive exam. The midterm will test the material covered in the first eight weeks. The final will include material covered from the beginning of the semester, with more weight on the material covered after the midterm (weeks 9-15). IN NORMAL CIRCUMSTANCES, NO MAKEUP QUIZZES OR EXAMS WILL BE GIVEN. If the student must miss a quiz or an exam, and the student has a legitimate reason, prior to the exam, the student must notify the



instructor that the exam will be missed. The student must present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc., clearly stating the date AND time of the mitigating problem. If these conditions are met, the score on the comprehensive final exam will be substituted for the quiz or exam the student missed. Otherwise, a ZERO score will be given for the missed quiz or exam. If the Final Exam is not taken, under rare circumstances where the student has a legitimate reason for missing the final exam, a makeup exam will be administered.

## Laboratory:

The laboratory is an integral part of this course, and each student must register for and attend the lab section. There is a weekly 3-hour lab session associated with this course. Please note that the first lab session will not take place until Thursday, 25 January 2024. You are expected to start working on the homework assignments prior the lab sessions and complete the programming parts of the homework assignments during the laboratory session. During the lab sessions you should not expect me to provide answers to your every question, as the laboratory is a place of self-discovery. This process may require outside reading/research prior to the day's lab session.

### Student Code of Conduct:

You are expected to submit work that is your own and properly acknowledge the work of others. You are responsible for understanding and adhering to the Student Code of Conduct that is printed in the UAF Course Catalog. Violations of the Code will be reported to the Dean of Students.

## **Disabilities Services:**

If applicable, it is your responsibility to arrange for these services. The UAF Center for Health and Counseling provides services for UAF students with disabilities to ensure equal access to educational opportunities. The Center's Disability Services Program ensures compliance with \$504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. If you believe you are eligible for 504 and/or ADA accommodations, please contact them at 474-7043 (WHIT 203).