Fall 2017 Physics 471 CRN 26423

Professor
Dr. Jared Workman

Class Location
WS 218

Class Hours
Mon Wed Fri 9:00-9:50

Text Book
Computational Physics, Mark Newman, 1480145513

Course Website
http://org.coloradomesa.edu/~jworkman/teaching/fall19/471/index471.php. If you ever forget the link to this site go to www.jaredworkman.com and scroll down to the "My Colorado Mesa University Webpage" link.

Welcome to Physics 471, Computational Physics 1

This syllabus is your guide to class policies and procedures as well as a tool for planning. Each student is encouraged to work with the instructor and their peers.

This course is going to be time consuming. This course is going to require a great deal of work. It will be moving quickly and you will get a lot of new math thrown at you. As a first step, download and install Anaconda Python on a machine you have regular access to.

CMU Catalog Description

Foundation covering application of computational techniques to solving physical problems. Numerical integration, differentiation, and matrix methods covered. Techniques of solving various regular and partial differential equations studied. Application of discretizing numerical solutions for physical problem stressed. Turning analytic problems into solvable computational schemes. Data analysis and visualization covered. Familiarity with any programming language is required. For any Science, Engineering or Mathematics major. Prerequisites: MATH 260 or MATH 236, and PHYS 311 or PHYS 321 or PHYS 342 or instructor permission.

What to look for in this syllabus

- How to contact me
- Evaluation (grades)
- Homework
- Exams
- Attendance
- Reading Schedule
- Course objectives and outline
- Resources for student assistance
- Student Conduct
- Important Dates

- Course Learning Objectives
- Student Learning Objectives
- Work Load

How to Contact Your Instructor

Visit my office: WS 230C
Office Hours: Mon/Wed/Fri 11:00-12:00, Thu 1:30-3:30
Leave me a message at: (970)-248-1327 (email is much better I don't generally look at my phone)
Email me at: mailto:jworkman@coloradomesa.edu

Evaluation

Homework 80%
Exams 10%
Attendance 10%

Grades will be assigned as follows:

Excellent	A	> 90%
Good	B	80%-90%
Average	C	70%-80%
Deficient	D	60%-70%
Failing	F	< 60%

A curve will likely be used this semester as it is the first time the course is being offered.

Homework

1. Home work constitutes the bulk of the grade in this class and will be posted on the course website. You are expected to keep track of homework on your own although I will announce it in class.
2. This is not a course on programming, you will be expected to self teach yourself what you do not know although I will make sample code available.
3. As a general rule, you must code up the methods from scratch the first time a new method is introduced, after this you may use built in Python procedures which accomplish the same task.
4. Homework is late if it is not ready at the beginning of the class on the due date.
5. Late homework is penalized at 25% per day of being late. You miss 25% for failing to be prepared on the due date and a further 25% for every day thereafter where the assignment is not handed in by 11:00 am on that day.
6. Each assignment will require a copy of your code as well as plots, charts, figures, etc. along with a description of your results. I will tell you the exact format I want your homework to be handed in for each assignment. I will penalize you for failing to hand in the homework in the format I describe.
7. I strongly encourage working together but identical code and graphs will result in the homework credit being spread amongst the students handing in identical work. As an example, if the homework grade is a 90 percent but I receive three identical assignments each student will be given 30 percent as a homework grade.
8. This is a very self-focused course, it will be taught much more like a lab. I expect you to use any and all resources at your disposal to complete the assignments. Most of what we will be covering has pre-existing code you can find on the internet.

Exams

- There will be one exam, the final. The final will be an oral examination. You will be expected to be able to explain what method you would use to solve a certain problem and describe the pitfalls and possible complications associated with the method. You will also be expected to describe how you would check the validity of your results as well as how to best present them to a general audience. The final is worth 10 percent of your grade.

Attendance

Attendance is 10 percent of the class. You will be unlikely to pass the course if you do not attend.

Reading Schedule

The reading is self-paced. Read the sections of the book that corresponds to the topics being covered. You should read the sections on relevant material immediately after the class the material has been presented in has passed.

Course objectives and Outline

Learn (Topical Course Outline)

- The Fundamentals of Computational Physics
    - Numerical Differentiation
        - Over both single, and multiple dimensions
        - Over scalar functions and vector functions
    - Numerical Integration
        - Single and multiple dimensions
        - Proper and improper
        - Scalar and vector functions
    - Numerical Solutions of Ordinary Differential Equations
        - Euler
        - Runge Kutta
        - Leap Frog
        - Adams Bashforth
        - Shooting Schemes
        - Additional methods as required
    - Numerical Solutions of Partial Differential Equations
        - Hyperbolic (example – wave equation)
        - Elliptic (example – Laplace's Equation
        - Parabolic (example – diffusion equation, Poisson's equation)
        - Mixed (example – Navier Stokes equation)
    - Minimization Schemes
    - Monte Carlo Schemes
    - Truncation Error
    - Precision
    - Stability
    - Efficiency

This course will be taught in a mixed lecture/laboratory format. I will spend some time lecturing with the rest of the class period being used for hands on work. I will MOST certainly not cover everything outline above. This is the first time the course is being offered so expect some fluidity in the pace at which material will be covered. Some homework will be trivial and some will be very difficult. I will assign a set number of points for each homework set that matches its difficulty accordingly.

Resources for Students

Your instructor: I am here to help you learn; please let me know if you are having trouble with anything! My contact information is at the top of the syllabus, or you can talk to me after class or during my office hours.

The Course Website: Contains all class information and several helpful (and some just fun) links.

Tutorial Learning Center: HH113 http://www.coloradomesa.edu/tutoring/index.html

Students With Disabilities: Students with disabilities have certain privileges extended to them including but not limited to extended exam time. It is your responsibility to contact the EAS (Educational Access Services) At Houston Hall, Room 108, 1-970.248.1856 http://www.coloradomesa.edu/eas/links.html and bring me the necessary forms for any special dispensations received.

Class Policies

All students expected to follow the Student Code of Conduct. Violations of the Student Code of Conduct may result in disciplinary action. The code of conduct is here here http://www.coloradomesa.edu/academics/policies/academic_integrity.html. Some specific items that are important in this class are:

1. Don't call me mister, it's Dr. Workman.
2. Create and sustain a respectful and quiet learning environment. Allow your fellow students to learn and the instructor to teach. Disrespectful, disruptive or abusive behavior toward an individual or group is unacceptable. If you disrupt your classmates I will dis-enroll you from the course.
3. Due to the rapid pace of this course, late work is generally not accepted. In the event of illness, family emergency or other special circumstances, you must contact me BEFORE the deadline to make arrangements for late work or early tests. At the instructor's discretion, you may then turn in the work within 1 week of the deadline.
4. I encourage participation, ask questions, email me, ask for reading material for your own edification after the course is over, provide me with feedback. I am not directly grading you on participation but it will play a factor in the end of the semester grade. This is an interesting topic and I want you to be involved in learning it.
5. Turn off your cell phone.
6. No smart phones, ipads, earphones, etc. during class time, no texting or web browsing. You all get one freebie phone ring then I may ask you to leave. I reserve the right to temporarily or permanently remove a student for the continued disruptive use of electronic equipment.
7. Laptops are fine for note taking but please do not web surf during class. If I find you surfing the web you forfeit your laptop privileges. Students using laptops are required to sit at the front of the class.
8. I will turn any students I find cheating, copying each other's work, or plagiarizing material over to the department chair, no exceptions. If you are unsure if something is prohibited, ask me. You are encouraged to work together but please do not hand in identical assignments, they will not be accepted.
9. Please arrive to class on time and wait until class is over to leave. I will remove students who regularly arrive late from the course.
10. It is your responsibility to learn of any missed work.
11. Don't talk during class, raise your hand whenever you want to but don't talk. I reserve the right to require you to leave the class for the day or completely dis-enroll you from the course for talking during lecture.

Important dates:

http://www.coloradomesa.edu/registrar/dates.html

Course Learning Objectives

1. Numerical integration of single and multiple dimensional integrals over scalar functions and vector fields
2. Numerical differentiation of single and multiple dimension scalar and vector functions
3. Various techniques to solve ordinary and partial differential equations that are of spatial, temporal, and mixed forms including scalar and vector functions
4. An introduction to discretizing ordinary and partial differentiation
5. Minimization schemes
6. Monte Carlo Methods
7. An introduction to data analysis and visualization schemes
8. Preparation and delivery of solutions to numerical problems in physics

Student Learning Outcomes

The physics program has several learning outcomes that will be attained by graduates of the program; this course contributes to the attainment of these two objectives

1) Show fluency with the major fields of physics (classical mechanics, electromagnetism, statistical physics and quantum theory).
2) Use mathematical representations to analyze physical scenarios. This requires translating back and forth between physical and mathematical problems and using appropriate mathematics to aid in the analysis of the scenario. (In this course, the appropriate mathematics will need to be translated to a numerical form and solved computationally).
3) Communicate effectively about topics in physics.

Work Load:

An undergraduate student should expect to spend on this course a **minimum** of two hours outside the classroom for every hour in the classroom. The outside hours may vary depending on the number of credit hours or type of course. More details are available from the faculty member or department office and in CMU's Curriculum Policies and Procedures Manual. In reality you should expect to spend a great deal more than this minimum outside of class. In this class 5-20 hours of work a week may be reasonable.

Disclaimer:

The instructor reserves the right to modify the content of the course and nature of the material presented on the final. Adequate warning will be given to the class to allow students the time to adapt.