PHYS 513: COMPUTATIONAL PHYSICS

COURSE SYLLABUS: SPRING 2024

INSTRUCTOR INFORMATION

Instructor:	Dr. Matt A. Wood
Office Location:	Science 344
Office Hours:	M-F 9:00-10:00 AM, but don't hesitate to stop by any time.
Office Phone:	(903) 886-5486
University Email Address:	Matt.Wood@tamuc.edu
Preferred Communication:	Office Visit or Email or Discord
Response Time:	Usually <1 business day (slower nights/weekends)

COURSE INFORMATION

Class Hours: TR 11:00-12:15

Required Textbook: Mark Newman, *Computational Physics*, Edition: Revised 2013 (ISBN: 9781480145511)

Recommended textbook: Alejandro Garcia, *Numerical Methods for Physics (Python) Second, Revised (Python) Edition*. ISBN: 978-1548865498

Python (Anaconda Python distribution recommended)

Course Description

Numerical experimentation has supplemented laboratory experimentation and theory as a viable approach to studying the laws of nature. Students will learn techniques and traps of programming, and then learn to write computer code to solve applications including: finite difference methods; realistic classical mechanics problems including friction or *N* mutually-interacting bodies; Laplace's equation in electrostatics; wave motion; random processes including diffusion, cluster growth models, and the Monte Carlo method; Fourier transforms and Fourier filtering. Other topics as of interest to the students and instructor.

The *syllabus/schedule are subject to change.*

Student Learning Outcomes

1. To understand the basics of scientific, numerical simulation and modeling.
2. To learn to use to use the graphical capabilities of Matplotlib to visualize numerical solutions into highly interpretable forms.
3. To gain intuition for the quality of simulations results (just because a program runs without error does not guarantee the results are correct).

COURSE REQUIREMENTS

GRADING

Final grades in this course will be based on the following scale:

A = 90%-100%
B = 80%-89%
C = 70%-79%
D = 60%-69%
F = 59% or Below

Weights of the assessments in the calculation of the final letter grade.

Homework	60%
Project	10%
Midterm Exam	15%
Final Exam	15%
TOTAL	100%

Assessments

The best way to learn numerical experimentation is by practice, so that's what we'll be doing. I expect you to write your own code, and I will be checking for originality. Of course you can search Stackexchange for tips on how to do some part of a larger problem (e.g., "how do I find the index of the largest element in an array?" -> np.argmax()), but if you ask ChatGPT to write your molecular dynamics simulation code, then you're very clearly cheating. As with most things worth your time, the struggle to get your code working is a critical part to you learning how code effectively. There are really not any shortcuts. You will complete your homework assignments using Jupyter Notebooks.

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TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:
https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:
https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

Zoom Video Conferencing Tool
https://inside.tamuc.edu/campuslife/CampusServices/CITESupportCenter/Zoom_Account.aspx?source=universalmenu

ACCESS AND NAVIGATION

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu**.**

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

COMMUNICATION AND SUPPORT

If you have any questions or are having difficulties with the course material, please contact your Instructor.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

The *syllabus/schedule are subject to change.*

Interaction with Instructor Statement

COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook http://www.tamuc.edu/student_guidebook/Student_Guidebook.pdf

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum: https://www.britannica.com/topic/netiquette

TAMUC Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedures 13.99.99.R0.01
http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf

Academic Integrity

Students at Texas A&M University-Commerce are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:

Undergraduate Academic Dishonesty 13.99.99.R0.03
Undergraduate Student Academic Dishonesty Form

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http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/documents/13.99.99.R0.03UndergraduateStudentAcademicDishonestyForm.pdf

Graduate Student Academic Dishonesty Form

http://www.tamuc.edu/academics/graduateschool/faculty/GraduateStudentAcademicDishonestyFormold.pdf

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
Texas A&M University-Commerce
Velma K. Waters Library Rm 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu
Website: Student Disability Services

https://www.tamuc.edu/student-disability-services/

Nondiscrimination Notice

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal

Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the Carrying Concealed Handguns On Campus document and/or consult your event organizer.

Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

A&M-Commerce Supports Students' Mental Health

The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit **www.tamuc.edu/counsel**

AI Use Policy

Texas A&M University-Commerce acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

The use of generative AI tools (e.g. ChatGPT, Dall-e, etc.) is permitted in this course for the following activities:

- Brainstorming and refining your ideas;
- Fine tuning your research questions;
- Finding information on your topic;
- Drafting an outline to organize your thoughts; and
- Checking grammar and style.

The use of generative AI tools is not permitted in this course for the following activities:

- Impersonating you in classroom contexts, such as by using the tool to compose discussion board prompts assigned to you or content that you put into a Zoom chat.

- Completing group work that your group has assigned to you, unless it is mutually agreed upon that you may utilize the tool.
- Writing a draft of a writing assignment.
- Writing entire sentences, paragraphs or papers to complete class assignments.
- Generating solutions to coding problems.

You are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws, or contain misinformation or unethical content). Your use of AI tools must be properly documented and cited in order to stay within university policies on academic honesty. Any assignment that is found to have used generative AI tools in unauthorized ways will result in a zero for that assignment. When in doubt about permitted usage, please ask for clarification.

COURSE OUTLINE / CALENDAR

- Python/Matplotlib review
- Accuracy and Speed
- Integrals and Derivatives
- Solution of Linear and Nonlinear Equations
- Fourier Transforms
- Ordinary Differential Equations
- Partial Differential Equations
- Random Processes and Monte Carlo Methods
- Nonlinear Dynamics, Fractals, Chaos
- Molecular Dynamics and N-Body Simulations
- Modelling Data