PHYS 536: Computational Physics

COURSE SYLLABUS: Summer 2024

INSTRUCTOR INFORMATION

Instructor: Dr. Matt A. Wood
Office Location: STC 343
Office Hours: Tuesdays at noon central time online in zoom.
Discord Server: Will send invite to all students.

University Email Address: matt.wood@tamuc.edu

Preferred Form of Communication: Email or Discord
Communication Response Time: Within 48 hours on weekdays and weekends

COURSE INFORMATION

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

Readings – Readings will be made available at least one week prior to the deadlines of the reading reflection assignments.

N. T. Young and A. F. Heckler, “Observed hierarchy of student proficiency with period, frequency, and angular frequency,” Phys. Rev. PER 14, 010104 (2018)

Bott et al., “Student-identified themes around computation in high school physics,” Physics Education Research Conference (2019)

J. Lincoln, “Using online tone generators,” Phys. Teach. 55, 244 (2017)

C. Harder-Viddal, "Another Look at Combination Tones,” Phys. Teach. 57.5: 315-319 (2019)

W. Garver, “When Do Two Waves Create a Heterodyne Wave?,” Phys. Teach. 57, 312 (2019)

TOB. Ogden and J. Burk, “Computational Essays in the Physics Classroom,”Phys. Teach. 58, 252 (2020)

The *syllabus/schedule are subject to change.*

E. Behringer, "AAPT recommendations for computational physics in undergraduate physics curricula." Bulletin of the American Physical Society 62 (2017)

A. Cromer, "Stable solutions using the Euler approximation," Am. J. Phys. 45, 455–459 (1981)

T. Timberlake and J. E. Hasbun "Computation in classical mechanics," Am. J. Phys. 76, 4&5 (2008)

Course Description

This course covers computational physics from a variety of perspectives. The course will include computational methods and advanced wave content. The course will also include history of the subject incorporation into physics curriculum, current events in computational physics, and physics education research relevant to computational physics will be discussed.

Note that the advanced content requires some knowledge of calculus, differential equations, and vector calculus.

University Catalogue Description

The basics of Python programming will be introduced. Different methods of integration, derivations, solving differential equations, plotting and use of libraries will be introduced in the context of advanced waves topics. Wave topics in harmonic oscillatory physical systems such as Mass-Spring will be explored. The physical properties of a traveling wave through a medium will be explored. Modern topics such as Chaotic systems will be introduced. Emphasis will be placed on programming and conceptual understanding.

Student Learning Outcomes

1. Students will be able to use computational techniques in Python to interpret different quantities of physical systems in the context of computational physics.
2. Students will be able to apply numerical methods in Python to calculate integrals, derivatives and solve differential equations.
3. Students will be able to discuss the application of findings of physics education research to their own classrooms.
4. Students will be able to incorporate history and current events in physics into their own teaching.

COURSE REQUIREMENTS

Minimal Technical Skills Needed

Students should be able to use myLeo Online, view videos on YouTube, and use scanners and pdf combiners. Students will need to use Python development tools (e.g., Anaconda Python, Spyder, and Jupyter Notebooks).

Instructional Methods

Each week, videos will be available introducing the week's computational physics content. A discussion board can be found under each week for you to discuss working these problems and your homework problems. A document will be uploaded introducing each reading assignment and containing prompts for your reading reflection. A discussion board can be found under each week for you to discuss the reading assignment. Problem set homework and reading reflection homework will be due approximately every week. See the schedule at the end of the syllabus. There will be 1 midterm exam and a final project covering the advanced computational physics content.

Note: You must submit at least one thread-starting post and one response post per Problem-Solving Discussion Topic, and at least one thread-starting post and two response posts per Reading Discussion Topic. Of course, you are welcome and encouraged to submit more than the minimum number of posts.

Student Responsibilities or Tips for Success in the Course

Students are expected to watch the videos, participate in all discussions, complete all homework assignments, and complete all exams. Students are to be aware of all deadlines and ask questions when directions are unclear.

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

Assessments

Grades will be based on 5 components:

- 20% Exams (midterm exam and final project)
- 40% Problem set homework
- 20% Reading reflection homework
- 10% Problem discussion
- 10% Reading discussion

Midterm Exam and Final Project: There will be 1 midterm and a final project. They will be weighted equally, so each is worth 10% of your overall grade. See exam due dates at the end of the syllabus. The midterm exam will be made available one week before the due date. The midterm exam has a 2 hour time limit. It is your responsibility to set aside a time when you can complete the exam and follow the time limit. The exam will

be a PDF that you will print, then write on to complete, then scan with an app that creates PDFs and upload (more on this in the detailed instructions for the exam). The instructions for the final project will become available in the middle of the semester.

Problem set homework: Problem sets will be assigned approximately once a week and will generally be due on Wednesdays at 11:59 pm. See the schedule at the end of the syllabus. Problem sets will generally be made available on Fridays 13 days before the due date. Assignments will be graded 50% for effort and 50% for correctness. For example, if you fully attempted each problem but every answer was incorrect, you would receive a grade of 50. Please submit your homework as Jupyter notebooks (.ipynb extension). You are strongly encouraged to discuss your problem set homework with fellow classmates on the class discussion boards and Discord server.

Reading reflection homework: Reading assignments will be due approximately every other week. See the schedule at the end of the syllabus. Each reading assignment will be an article about history, current events, or physics education research. You will write a reading reflection based on the assigned prompts. A document will be made available containing the rubric for how reading reflection homework will be graded. You should submit your reading reflection as either a Word document or a pdf document through the myLeo Online.

Problem discussion: You are expected to participate in the problem discussions either to discuss the sample problems or to discuss the problem set homework. A document called Problem Discussion Rubric will be made available so that you understand how you will be graded for your participation in this discussion. Problem discussions will generally open on Mondays and the due date will be the following Monday for your thread-starting post. You must make your first (thread-starting) post in the problem discussion forum no later than the Monday listed as the due date in myLeo Online at noon, and a second response post within a week of the deadline.

Reading discussion: You are expected to participate in discussions about the reading assignments. A document called Reading Discussion Rubric will be made available so that you understand how you will be graded for your participation in these discussions. You must make your first post in the Reading Discussion forum no later than Monday at noon in the week that the Reading Discussion is due. You must write at least three posts total by the assigned deadline for the Reading Discussion. At least two of these posts should be responses to other students' posts.

TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo D2L 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

YouSeeU Virtual Classroom Requirements:
https://support.youseeu.com/hc/en-us/articles/115007031107-Basic-System-Requirements

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

Interaction with Instructor Statement

The best method to reach the instructor is through email. You can send an email to matt.wood@tamuc.edu with PHYS 536 in the subject line.

The instructor will also be available through the virtual office for general questions.

The instructor will hold office hours on Zoom. When office hours are held through Zoom the URL(s) will be posted in class announcements. The method for office hours will be posted in class announcements a week in advance.

The instructor will participate on class discussion boards. Please restrict these discussion boards to their labeled topics.

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COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

1. You are responsible for knowing when all deadlines are.
2. You are responsible for asking for clarification whenever directions are unclear to you.
3. When emailing the instructor, include the course number in the subject line.
4. You are expected to check D2L for class announcements at least once a day.
5. You are expected to check your email at least once every 48 hours for messages from the instructor. Emails will be sent to the email addresses you provided to MyLeo. Notify the instructor if you would prefer to receive emails at a different address.
6. Homework and exams are due by 11:59 pm on the specified due dates. Late homework will be accepted up to a week late at 50% off. Late exams will not be accepted except in extenuating circumstances.
7. Students are expected to be professional and respectful and follow netiquette.

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/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx

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 Procedure 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

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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

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

Graduate Student Academic Dishonesty 13.99.99.R0.10

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10GraduateStudentAcademicDishonesty.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
Gee Library- Room 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu
Website: Office of Student Disability Resources and Services
http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

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.

COURSE OUTLINE / CALENDAR

Computational Physics Content Schedule
Weeks are labeled by the Monday of each week.

6/3	Week 1:	Introduction to Python I
6/10	Week 2:	Introduction to Python II
6/17	Week 3:	Matplotlib, Seaborn, VPython, Accuracy and Speed
6/24	Week 4:	Integrals and Derivatives
7/1	Week 5:	Solution of Linear and Nonlinear Equations
7/8	Week 6:	Fourier Transforms
7/15	Week 7:	Ordinary Differential Equations
7/22	Week 8:	Ordinary Differential Equations and Random Processes
7/29	Week 9:	Random Processes and Monte Carlo Methods

Problem Set Homework Deadlines:
Problem sets will be made available at least one week before the due date.

Homework 0: Kaggle Intro Programming & Python	6/12
Homework 1: Chapter 2	6/19
Homework 2: Chapter 3 & 4	6/26
Homework 3: Chapter 5	7/3
Homework 4: Chapter 6	7/10
Homework 5: Chapter 7	7/17
Homework 6: Chapter 8	7/31
Homework 7: Chapter 10	8/8

Reading Reflection Homework Deadlines:

RR Homework 1	6/14
RR Homework 2	6/21
RR Homework 3	6/28
RR Homework 4	7/21
RR Homework 5	7/26
RR Homework 6	8/2

Exam due dates: Midterm Exam will be made available 1 week before the deadline. The Final project instructions will be made available in the middle of the semester.

Midterm	7/12
Final Project	8/8

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