

Physics 309
Mathematical Methods for Scientists
Spring, 2021

Meets:

2:00 pm – 3:50 pm
Tuesday, Thursday
150 Meldrum Hall

Instructor:

Dr. Christopher Cline
278 Meldrum Hall
832-2346
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Textbook:

Required: *Mathematical Methods in the Physical Sciences*, 3rd Ed., Mary L. Boas.
We plan to be covering chapters 1 – 9, and chapter 12.

Course Description: Physics 309 is a sophomore/junior level course in mathematical methods for chemists and physicists. The purpose of this class is to give you some of the math tools you will need for upper division and graduate school chemistry and physics courses. I will try to give this more coherence by helping you understand the physical relevance of the mathematics we learn. My goal is to have minimal lecturing and lots of discussion from your readings. Also, I hope to have lots of problem solving. I'll do some in class; you'll do lots in class; you'll do lots more at home. The proposed sequence of topics is as follows:

- Introduction to Mathematica (handout)
- Coordinate Systems (pages 260 & 261, handout)
- Series (Chapter 1)
- Complex numbers, complex algebra, functions of complex variables (Chapter 2)
- Basic linear algebra: matrices, determinants, diagonalization, eigenvalues & eigenvectors (Chapter 3)
- Partial Differentiation (Chapter 4)
- Multiple integrals; Coordinate systems (Chapter 5)
- Vector calculus and integral theorems (Chapter 6)
- Fourier series (Chapter 7)
- Ordinary Differential Equations (Chapter 8)
- Series Solutions to Differential Equations (Chapter 12)
- Calculus of Variations (Chapter 9)

Conditions of enrollment: Physics 211 (Physics for Scientists & Engineers I) and Math 202 (Calculus II) are prerequisites for all students enrolled in this course.

How to get help: My office hours are **M 3:00 pm - 5:00 pm**, **W 1:00 pm - 4:00 pm**, **TTh 10:00 am - 12:00 pm**, and **TTh 4:00 pm - 5:00 pm**. If you can't come during any of these hours, I will be happy to make an appointment with you for another time. For me, *the* most enjoyable aspect of teaching is working with students one-on-one. *Please, please* come see me often—*especially* if you run into difficulties with concepts you encounter in the readings.

Class Attendance and Participation: Class meetings are TTh 2:00-3:50. Preparation for class, attendance, and participation will be rewarded. I have included a schedule of topics with this syllabus along with the readings to be studied *before* each class meeting.

Reading Memos: It is nearly useless to read a physics text as you would a novel. “Studying” such a text requires that you be an *active* reader, that you remain engaged in a virtual and *appropriately skeptical* conversation with the author. You should, for example: (1) reserve doubt about everything the text says until it thoroughly convinces you, (2) think about situations to which the author's arguments might not apply, (3) make notes in the margins, (4) draw your own sketches and graphs to help visualize situations and functional behaviors, and *especially* (5) fill in all of the missing steps in any mathematical arguments. Indeed it is *all* too tempting to simply take the author's word for everything including the results of any calculation; after all, he or she wouldn't consciously *lie* to you, right? Well, yes; probably. But if you get into that habit, you will become a *passive* reader. Your mind forms no permanent “hooks” on which to store the information being presented. The time spent in the process may well be reduced, but will also have been essentially wasted.

Perhaps mathematician Paul R. Halmos gave the best advice about how to study: “*Study actively. Don't just read the text; fight it! Ask your own questions, look for your own examples, discover your own proofs.*” (*I Want to Be a Mathematician*, New York: Springer-Verlag, 1985)

Accordingly, in order to help you form or hone these important good study habits, I will ask you to produce and turn in a "Reading Memo" at the beginning of each day for which there is assigned reading. A "Reading Memo" is an informal running collection of thoughts about and reactions to the material in the text. As you study, keep a pencil in hand and note any questions that occur to you; any surprises, insights, or connections to other things you know about; anything you think may be wrong or incomplete and why you think so; anything you think could be said more clearly and your proposed revision; etc. Beyond their effectiveness at helping you to stay engaged as you study, your Reading Memos will also help me to understand those items and topics that may require more attention in class.

Your Reading Memos will be given full (2 pts) or half credit (1 pt) *purely* on the basis of whether or not it appears that your good faith effort was involved and *not at all* on the basis of format, sophistication, vocabulary, correctness, etc. In order to allow for extraordinary circumstances (*including* absence for *any* reason), I will throw out up to three "missing" Reading Memos.

Homework: I will make regular Homework Assignments due at intervals of very approximately a week and a half to two weeks at the beginning of a specified class meeting.

As you surely know by now, the primary purpose of assigned problems in physics is *absolutely not* to see if you can get the right answer. Rather, it is for you to practice and then demonstrate that you have learned 1) how to determine the fundamental physical principles that are involved in a described situation and 2) how to apply those principles in a disciplined and orderly fashion. Of course, if you have learned how to do these things, you should expect to get the right answer too, but that is - really - of secondary importance. You will find - indeed, you probably have found - that, given time, an open book, lots of worked examples, and knowledge of the correct answer, it is very often possible to "get the answer" without the slightest understanding of what you are doing. Please guard against this; it is a complete waste of your time because it does not prepare you for, and it obviously will not work on, exams.

Accordingly, we are not - and you should not be - satisfied with problem "solutions" that simply consist of a series of mathematical manipulations leading to a result. Instead, the problem solutions you submit are to be "presented." By this we mean that they should be readable by someone who does not have access to the problem statement; should include written explanations and thoughtful comments about what you are doing and, especially, why; should use well-defined and consistent notation (employing unique and meaningful subscripts and superscripts as necessary); should be accompanied by neatly drawn and carefully labeled diagrams; and should flow in a logical and orderly progression down the page. They should use more space for the written explanatory information than for the mathematics! They should *not* include lengthy, multiple-step, purely mathematical manipulations because it only serves to obscure the physics. Do this kind of work on scratch paper and simply say something like "Solving equations 1, 2, and 3 for x , y , and z , we obtain ..." and give the result.

I will not "check" your homework solutions in any in-depth fashion; it is up to *you* to check them against the solutions that I will hand out and to get answers—from me or others in the class—to any remaining questions you have. I will look over each problem of your work only casually and assign a holistic score of 5- 10 for each problem. See the Homework Rubric for more information, but briefly: a 9 or 10 point assignment work shows a correct understanding of the concepts and explains them clearly to a new learner. A 7 or 8 point assignment is generally correct but not clearly explained, or contains misunderstandings but is clearly written. A 5 or 6 point assignment demonstrates little understanding of the concepts or is so poorly written (or absent) that the reader can't understand. Unsubmitted problems or problems submitted with minimal development will receive a 0.

Problems that receive a score of 5-8 may be redone and resubmitted within 5 calendar days from the return of the original work. All resubmitted problems must include a thoughtful reflection on your original work and mistakes. The final score will be the average of the score on the original work and the score on the resubmitted work.

I *strongly* encourage you to form study groups and to discuss with others your readings, questions that come up in and out of class, and how to go about solving problems. The work *you* turn in, however, must be *yours*, based on the understanding *you* have acquired. When faced with two write-ups that show any signs of copying, I conclude that at least one person hasn't done the work. In such cases both papers will receive no credit.

I do not accept late Homework Assignments, but, in order to allow for extraordinary circumstances (*including* absence for *any* reason), I will throw out your two lowest scores.

Subjective Bonus: A small portion of your grade is also determined by my own overall subjective evaluation of your work in the class. Although it is subjective, my policy is that it will *not* be less than the average of your Reading Memo and Homework scores. It allows me *only* to *reward* students who make contributions to the class that may not be fully recognized, who make particularly effective use of office hours, or who, in any other way, seem to deserve a bit of *additional* credit.

Exams: There will be two to three exams, either in-class or take home. The materials that you may use for each exam will be announced ahead of time. I will provide things that I do not expect you to have (for example, a table of Fourier Transforms). Some of the tests may include using *Mathematica* on the computer. You may not work with or gain assistance from anyone except members of the Westminster physics faculty. Of course, I trust you will do all your own work on the exam. If you are caught cheating on an exam, you will receive an F for the exam for the first offense; for a second offense, an F for the entire course.

Grading: Your overall “Course Score” will be calculated using the following relative weights:

Reading Memos	10%
Homework	20%
Subjective Bonus	10%
Exams	20-30% each

Academic Integrity: Please make sure that you have read and fully understood Westminster's Policy on Academic Honesty (and Dishonesty) that appears in the Academic Catalog. My sincere desire is to act as facilitator—not an enforcer—for your studies in physics. Accordingly, I operate on the assumption that all of our interactions are based on openness, honesty, and good faith. I expect all of us to be honest and to treat each other fairly and with respect. Because our trust in each other is absolutely *crucial* to the effectiveness of our relationship, I take an uncompromising stance, as should you, on the necessity for sanctions when it is violated.

Pronouns, Correct Names, and Inclusion: It is your right to be identified by your correct name and pronouns. I support people of all gender expressions and gender identities and welcome students to use whichever pronouns or names that best reflect who they are. In this spirit, I expect all students to also use the correct pronouns and names of classmates. Please inform me if my documentation reflects a name different than what you use and if you have any questions or concerns please contact me after class, by email, or during office hours.

The scientific enterprise does not have a “clean record”_with regards to respecting, including, and encouraging people from all backgrounds. There are many stereotypes floating around our cultural narrative about who can or should be a scientist/engineer. It is very important in this class to value the contributions from every student and encourage one another to rise to the challenge of the tasks ahead of us this semester.



Face Covering Requirement: The College’s Policy 521 on Complying with COVID-19 Guidance governs all students, faculty, staff, and campus visitors in all College-owned, leased, or operated facilities. Face coverings **MUST** be properly worn at ALL times in ALL classrooms, both indoor and outdoor. Accordingly, no consumption of any food will be allowed in classrooms, both indoor and outdoor.

As the instructor of this course, I shall comply fully with Westminster College’s policy. Students who attempt to enter a classroom without face coverings will be asked by the instructor to wear face coverings prior to entry, and will not be admitted into the classroom without a face covering. Students who remove their face coverings at any time during a class session will be asked by the instructor to resume wearing their face coverings.

Students who do not comply with a request by a Westminster College instructor to wear a face covering in accordance with the College’s Policy may be subject to disciplinary actions per the rules, regulations, and policies of Westminster College, including but not limited to the Student Handbook.

Non-compliance with this policy may result in disciplinary action, up to and including any of the following:

- dismissal from the course(s)
- removal from campus housing (if applicable)

- dismissal from the College

To immediately protect the health and well-being of all students, instructors, and staff, instructors reserve the right to cancel or terminate any class session at which any student fails to comply with faculty or staff request to wear a mask in accordance with College policy.

Students are strongly encouraged to identify to their instructor any student or instructor not in compliance. Non-compliance may be anonymously reported via the Incident Reporting Form (<https://westminstercollege.edu/about/risk-management/coronavirus-covid-19-resources/covid-19-comments-questions-and-incident-reporting>)

Section 504 of Rehabilitation Act of 1973/ADA: Westminster college is committed to provide equal access in higher education. If you need disability-related accommodations in this class, have emergency medical information you wish to share with me, or need special arrangements in case the building must be evacuated, please inform me immediately. Please see me privately after class or in my office. Disability Services authorizes disability-related academic accommodations in cooperation with the students themselves and their instructors. Students who need academic accommodations or have questions about their eligibility should contact Jody Katz, Director of Disability Services & Testing Center, in the basement of Giovale Library (801-832-2272) or email disabilityservices@westminstercollege.edu.

Title IX: Westminster College is committed to providing a safe learning environment for all students that is free of all forms of discrimination and sexual harassment. This includes discrimination based on sexual orientation, gender identity and gender expression. If you (or someone you know) has experienced or experiences any of these incidents, know you are not alone. Westminster College has staff members trained to support you in navigating campus life, accessing health and counseling service, providing academic and housing accommodations, and more.

Please be aware all Westminster College faculty members are “mandatory reporters” which means if you tell me about a situation involving sexual harassment or gender discrimination, I must report that information with the Title IX Coordinator. Our goal is to make sure you are aware of the range of options available to you and have access to the resources you need.

If you wish to speak to someone, you can contact any of the following on-campus resources:

- Counseling Center (egibson@westminstercollege.edu or 801-832-2237)
- Student Health Services (801-832-2239)
- Victim’s Advocate- Andreja Nadjalin (advocate@westminstercollege.edu)

If you wish to make a report directly to the Title IX Office, please complete the online reporting form located on www.westminstercollege.edu/titleix or contact Mary Royal at 801-832-2496 or mroyal@westminstercollege.edu. The Title IX website contains more information about resources, rights, policy and procedures, and updated information regarding our Title IX program at Westminster College.

Equal Opportunity: Westminster’s Equal Opportunity policy prohibits discrimination or harassment based on age, color, disability, ethnicity, genetic information, military status, national origin, race, religion, pregnancy and related conditions, childbirth, gender identity, sex, or sexual orientation in any of its programs or activities. Westminster is committed to providing a safe and non-discriminatory environment for all members of the College community, including those whose gender identity and/or expression differs from the sex assigned to them at birth. Harassment and discrimination based on gender identity or expression is prohibited by the college and will not be tolerated. This includes refusal to address an individual by the gender they identify with. If you experience or witness prohibited conduct, or any form of discrimination or harassment, you should contact an Equal Opportunity Representative listed below.

- Mary Royal (801-832-2262 or mroyal@westminstercollege.edu)
- Julie Freestone (801-832-2573 or jfreestone@westminstercollege.edu)

The equal opportunity policy and procedures can be accessed from the Student Life webpage.

As a professor, just as with Title IX, I am a responsible employee and am required to report any information I obtain regarding discrimination or harassment to the Equal Opportunity Officer for further review.