

**Course Title: Method of Mathematical Physics**

**Course Number: PHYS 3120**

**Department of Physics**

**University of Colorado Denver**

**COURSE SYLLABUS**

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| Instructor Name: Masoud Asadi-Zeydabadi, Ph.D. | Instructor Phone: 303-315-7373 |
| Instructor Email: [Masoud.Asadi-Zeydabadi@ucdenver.edu](mailto:Masoud.Asadi-Zeydabadi@ucdenver.edu) | Office: NC 3803 or Computational Physics Lab: NC 3603 |
| Office hours: M/W12:00-12:50 pm  or by appointment in person or on zoom |  |
| Class Meeting Days: M/W 9:30pm-10:45pm | Term: Fall 2023 |
| Class Location: North-3111  Zoom link:  <https://ucdenver.zoom.us/j/98382296601> |  |

1. **Welcome!**

Mathematics is the language of physics. In this course you the application of mathematics in advanced physics problems. This course build the mathematics foundation of for some your physics course. I hope you enjoy this course through the beauty of Mathematics as the backbone of physics

1. **University Course Catalog Description**

Typically covers calculus of variations, special functions, partial differential equations, integral transforms, linear vector spaces, and tensor analysis.

1. **Course Overview**

The topics of this course are vector analysis, Fourier series, Fourier Transforms, the calculus of variations, series solution of differential equations, orthogonal function, special function in physics, partial differential equations, function of complex variable, tensor analysis and if we have had time, you might learn the basics of the probability and statistics.

1. **Course Goals and Learning Objectives**

The main goal is to learn the topics that have been described in course description and Overview. For example at the end of this semester, you should be able to apply the vector analysis in electricity and magnetism, get familiar with Fourier series, orthogonal function, special functions, and Sturm-Liouville equation, use Lagrangian (or maybe Hamiltonian) to solve analytical mechanics problems, get familiar to tensor and solve a wide range of partial differential equation in different coordinates that can be used in different field of physics. You would learn some application of these materials through working on project(s). By working on the computational projects, you will learn some numerical techniques such as Runge-Kutta and finite difference methods.

**Programming:**You don’t need to have a prior programing background for this class. Through the semester, you will learn some programming skills as you are working on the projects. I will use mainly MATALB for this class. You are welcome to use other languages or software such as Python and R. If you need to build your computational background stronger, I can offer some additional computational and MATLAB sessions. We have site license for MATLAB. The link to install MATLAB: <https://olucdenver.sharepoint.com/matlab/Pages/default.aspx>

**Computational sessions:**

Learning the basics of programming is not difficult. For those students who are not familiar with programming and computational methods, I offer some MATLAB sessions. Always you can meet with me to get help for computational projects.

1. **Course Prerequisites**

- Calculus III (MATH 2421)  
- Linear Algebra and Differential Equations (MATH 3195) (or equivalent) or permission of instructor.

1. **Course Credits**

3 credits

1. **Required Texts and Materials** Mathematical Method in Physical Sciences, third editions, by Mary L. Boas.
2. **Supplementary Texts and Materials**

You can refer to any advanced mathematical textbooks as additional resources. Here are some references:

* Mathematical Methods for Physics, Arfken
* Mathematical Methods for physics and engineering, K.F. Riley, M.P. Hobson and S. J. Bence
* Advance Engineering Mathematics, Kreyszic
* Methods of Mathematical Physics, Jeffreys & Jeffreys
* Method of Theoretical Physics, Morse and Feshbach
* Introduction to Mathematical Physics, Vaughn
* Modern Mathematical Methods for Physicists and engineers, Cantrell
* Methods of Mathematical Physics, Courant-Hilbert
* Mathematical Methods for Physics Using MATLAB and Maple, Claycomb
* Computational Physics, Giordano
* Numerical Method for Physics, Garcia

1. **Course Schedule**

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| --- | --- |
| **Week** | **Topic** |
| **1** | Review, Complex number**,** Partial differentiation, Partial differentiation, and multiple integrals, Vector analysis, |
| **2** | Vector analysis, Curvilinear coordinates |
| **3** | Vector analysis, Curvilinear coordinates |
| **4** | Fourier series and transformation |
| **5** | Fourier series and transformation |
| **6** | Ordinary differential equation, Linear algebra (eigenvalues and eigenvector; diagonalizing a matrix) Ordinary differential equation, Convolution, Dirac delta function and Green function |
| **7** | Convolution, Dirac delta function and Green function |
| **8** | Calculus of variation, Lagrange’s and Hamiltonian equations |
| **9** | Special Function |
| **10** | Series solution of differential equation, Sturm-Liouville equation, orthogonal function |
| **11** | orthogonal function, Legendre, Bessel, Hermite, and Laguerre Functions |
| **12** | Partial differential equation |
| **13** | Partial differential equation |
| **14** | Fall break |
| **15** | Partial differential equation |
| **16** | Tensor Analysis and probability and statistics |
| **17** | The finals week |

**EVALUATION**

1. **Assignments**

**Exam, Homework Assignments and projects**

**Exam:**

There are three exams for this class. They will be taken in-class or/and as take-home. It could be either closed or open book. Exam 2 can be an oral exam (group exam) and it can take for about 30-minuts-1:00 hour. In the case of the open textbook exam you need to bring your textbook with yourselves and you are not allowed to share your textbook with other students in the exam and the textbook should be clean (for example writing the solution of any problem in your textbook is considered as cheating).

**Homework Assignments:**

There is usually a homework assignment every week. A solution set will be provided for each homework assignments. Late homework will be accepted if it returns prior to handing the solution. The penalty for the late homework is 5% off per each class period late.

**Projects:**There are 3-5 computational projects that will be given during the semester. You will compare the analytical with numerical results in these projects and you should be able to interpret the results. In those projects, you will learn some computational techniques like Runge-Kutta and finite difference methods. You can use MATLAB, Python, R, or… for programming. These projects should be done as group projects. The group can be 3-4 students, we can talk more about group in the class.

**Paper and presentation**

The paper is on the application of this course. It should be 5-10 pages with appropriate references. The presentation should be outside class time and it should be before the final exam. You will with your group on your paper.

1. **Basis for Final Grade**  
   Homework: 20%

Projects: 8%

Paper and presentation 7%  
Exam I: 25% (Wednesday 10/11)

Exam II: 15% after fall break, before the finals week   
Exam III: 25% (Finals week or on the last day of class)

In the final grades plus and minus (A, A-, B+, B,…) will be used.

A: 91-100, A-: 89-91, B+:84-89, B: 81-84, B-:79-81, C+:74-79, C: 69-74, C-: 65-69, D: 55-65, F:0-55

1. **Grade Dissemination**

I will return the graded assignment in class. You may also turn some of your assignments on canvas and receive your grade on canvas.

To ensure your privacy when papers, projects, homework assignments and examinations are returned in class or made available for pickup, please provide me with a 9x12 envelope with your name on it each time you submit a paper, quiz, or examination to me.  
The final grades would be available through UCD Access.   
CU Denver utilizes web grading which is accessed through UCDAccess*.* All web grading information can be found at <http://www.ucdenver.edu/student-> services/resources/Registrar-dev/faculty- staff/WebGrading/Pages/WebGradingDenver.aspx

**COURSE PROCEDURES**

1. **Course Policies: Grades**

**Attendance Policy:**

You are responsible to learn the materials that are covered in this class. If you miss a class you are responsible to learn the materials. For any reason if you are not able to attend the class please inform me by an email.

UC Denver Student Attendance and Absences Policy: [http://www.ucdenver.edu/faculty\_staff/employees/policies/Policies%20Library/OAA/Stud entAttendance.pdf](http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/OAA/Stud%20entAttendance.pdf)

**Religious Observances:** Students must notify the instructor in advance if they intend to miss a class to observe a holy day of their religious faith.

**Late Work Policy:** Provide specifics about your policy on late work. Example: There are no make-ups for in-class writing, quizzes, the midterm, or the final exam. The assignment turned in late will be assessed a penalty: I will take 5 points off for each session overdue. It means for example if the homework is due Monday and you turn it two session late (on next Monday), you will get 5+5=10 points off as late turn penalty.

**Final Grades:** Your final grade is FINAL; no work may be handed in for additional credit after the final exam. Requests for regrading of assignments and exams must be in writing and must specify exactly why additional credit is warranted. No requests for changing a grade will be accepted more than 48 hours after an assignment or exam is returned.

**Grades of Incomplete:** The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course; students have up to one year (three semesters) to complete course requirements. Your instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished within the time allowed or the “I” will automatically be recorded as an “F” on your transcript.

1. **Course Policies: Technology and Media**

**Email:**UCD email is only email address will use for this course.

**Canvas:**   
I will use canvas for this class and you may need to submit some of your assignments through canvas.

**Laptop and Mobile Device Usage/ Classroom Devices:**

Usually, you don’t need them, However, if you want to use them for the leaning purpose you can use them. If we need to use computer during the class time I will let you know in advance. We can also go to the computational physics lab (NC 3603) if we need to do some computational programming.

1. **Course Policies: Student Expectations**

You are responsible to be prepared for the class, read and working on all assignments. Always you can learn the materials by reading and preparing yourself before the class and discussing and asking questions in the class and working on the assignment after the class. Working on the projects and paper helps you to understand the detail and the application of this course. You will basically control and run the class by asking questions and giving me feedback. I am open to consider you suggestions for any improve for this course.

The Student and Community Counseling Center is located in Tivoli 454 and provides cost-free and confidentia**l** mental health services to help students manage personal challenges that impact emotional or academic wellbeing. You can learn more at the Center at [http://www.ucdenver.edu/life/services/counseling-](http://www.ucdenver.edu/life/services/counseling-center) [center](http://www.ucdenver.edu/life/services/counseling-center) or by calling 303-556-4372.

**Campus Assessment, Response & Evaluation (CARE)**

the University of Colorado Denver and Anschutz Medical Campuses to address the health and safety needs of students as well as the campus community. The campus Assessment, Response & Evaluation (CARE) team’s purpose is to promote a safe productive learning, living and working environment by addressing the needs of students, faculty, and staff. If you or a classmate are in need of help, please submit a concern at <http://www.ucdenver.edu/life/services/CARE/Pages/default.aspx>or call 303- 352-3579.

Here are some useful links:

**Professionalism:**

<http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/7XXX%20Student%20Affairs/7004%20-%20Disruptive%20Behavior%20Policy.pdf>

**Electronic Cigarettes** (e-cigarettes): The use of e-cigarettes is distracting in the classroom environment not only to the instructor but to other students. The use of e- cigarettes during all classroom activity is prohibited. Any student who does not comply with this rule will be asked to leave the classroom immediately so as to not disrupt the learning environment. Pursuant to the Auraria Campus Smoking Policy, the use of e- cigarettes indoors and within twenty-five (25) feet of any entrance is strictly prohibited. [http://www.ucdenver.edu/faculty\_staff/employees/policies/Policies%20Library/Admin/S](http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/Admin/Smoke-Free.pdf) [moke-Free.pdf](http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/Admin/Smoke-Free.pdf)

**Auraria Library:**<http://library.auraria.edu/services/researchhelp/specialists>.

**Writing Center**: [http://www.ucdenver.edu/academics/colleges/CLAS/Centers/writing/Pages/TheWriting](http://www.ucdenver.edu/academics/colleges/CLAS/Centers/writing/Pages/TheWritingCenter.aspx) [C enter.aspx](http://www.ucdenver.edu/academics/colleges/CLAS/Centers/writing/Pages/TheWritingCenter.aspx)

1. **DISABILITY ACCESS:**

The University of Colorado Denver is committed to providing reasonable accommodation and access to programs and services to persons with disabilities. Students with disabilities who want academic accommodations must register with Disability Resources and Services (DRS) in Academic Building 1, #2116, Phone: 303-315-3510 , Fax: 303-315-3515. I will be happy to provide approved accommodations, once you provide me with a copy of DRS’s letter. Note: DRS requires students to provide current and adequate documentation of their disabilities. Once a student has registered with DRS, DRS will review the documentation and assess the student’s request for academic accommodations in light of the documentation. DRS will then provide the student with a letter indicating which academic accommodations have been approved.

*(If the student has been deemed eligible for accommodations by their high school, they will be issued a 504 plan. As the instructor, you may honor the school’s evaluation and grant the student the recommended accommodations in the 504, or you may instruct the student to request the accommodations from the office of Disability Resources and Services, which will conduct an evaluation and determine if the student is eligible for accommodations and what those accommodations should be)*

1. **Academic Honesty:**

**Student Code of Conduct**: Students are expected to know, understand, and comply with the ethical standards of the university, including rules against plagiarism, cheating, fabrication and falsification, multiple submissions, misuse of academic materials, and complicity in academic dishonesty. For suggestions on ways to avoid academic dishonesty, please see the Academic Honesty Handbook: [http://www.ucdenver.edu/faculty\_staff/faculty/center-for-faculty- development/Documents/academic\_honesty.pdf](http://spdev.ucdenver.edu/faculty_staff/faculty/center-for-faculty-development/Documents/academic_honesty.pdf)

Plagiarism is the use of another person’s ideas or words or data without acknowledgement. The incorporation of another person’s work into yours requires appropriate identification and acknowledgement. Examples of plagiarism when the source is not noted include: word- for-word copying of another person’s ideas or words; the “mosaic” (interspersing your own words here and there while, in essence, copying another’s work); the paraphrase (the rewriting of another’s work, while still using their basic ideas or theories); fabrication (inventing or counterfeiting sources); submission of another’s work as your own; and neglecting quotation marks when including direct quotes, even on material that is otherwise acknowledge.

Cheating involves the possession, communication, or use of information, materials, notes, study aids, or other devices and rubrics not specifically authorized by the course instructor in any academic exercise, or unauthorized communication with any other person during an academic exercise. Examples of cheating include: copying from another’s work or receiving unauthorized assistance from another; using a calculator, computer, or the internet when its use has been precluded; collaborating with another or others without the consent of the instructor; submitting another’s work as one’s own.

Fabrication involves inventing or counterfeiting information—creating results not properly obtained through study or laboratory experiment. Falsification involves deliberate alteration or changing of results to suit one’s needs in an experiment or academic exercise.

Multiple submissions involves submitting academic work in a current course when academic credit for the work was previously earned in another course, when such submission is made without the current course instructor’s authorization.

Misuse of academic materials includes: theft/destruction of library or reference materials or computer programs; theft/destruction of another student’s notes or materials; unauthorized possession of another student’s notes or materials; theft/destruction of examinations, papers, or assignments; unauthorized assistance in locating/using sources of information when forbidden or not authorized by the instructor; unauthorized possession, disposition, or use of examinations or answer keys; unauthorized alteration, forgery, fabrication, or falsification of academic records; unauthorized sale or purchase of examinations, papers, or assignments.

UC Denver has a license agreement with Turnitin.com, a service that helps detect plagiarism by comparing student papers with Turnitin’s database and Internet sources. Students who take this course agree that all required papers may be submitted to Turnitin. While students retain copyright of their original course work, papers submitted to Turnitin become part of the Turnitin’s reference database for the purposes of detecting plagiarism.

Complicity in academic dishonesty involves knowingly contributing to or cooperating with another’s act(s) of academic dishonesty.

1. **Nondiscrimination and Sexual Misconduct**

The University of Colorado Denver is commited to maintaining a positive learning, working and living environment. University policy and Title IX prohibit discrimination on the basis of race, color, national origin, sex, age, disability, pregnancy, creed, religion, sexual orientation, veteran status, gender identity, gender expression, political philosophy or political affiliation in admission and access to, and treatment and employment in, its educational programs and activities.

University policy prohibits sexual misconduct, including harassment, domestic and dating violence, sexual assault, stalking, or related retaliation. If you have experienced some sort of sexual misconduct or discrimination please visit the Office of Equity/Title IX web site to understand the resources available to you or contact the Office of Equity/Title IX Coordinator (1-844-288-4853).

<http://www.ucdenver.edu/policy/TitleIX/Pages/default.aspx>

1. **Important Dates to Remember**

Academic Calendar: <http://www.ucdenver.edu/student-services/resources/Registrar-dev/CourseListings/Pages/AcademicCalendar.aspx>

**Land Acknowledgment:**

Please see the flowing link "Land Acknowledgment".

<https://www.ucdenver.edu/offices/diversity-and-inclusion/our-offices/center-for-identity-inclusion/land-acknowledgement#ac-land-acknowledgement-2>

**Some useful links:**

Physics Department List of Online Supplemental Resources:

<https://clas.ucdenver.edu/physics/academics/online-supplemental-resources>

Course Format Guide:  
<https://www.ucdenver.edu/centers/cetl/course-design/course-format-guide>  
   
   
Student Experience Project Practices Library  
<https://collegetransitioncollaborative.org/sep-practices-library-by-construct/>  
   
Attendance and Participation Considerations:  
<https://www.ucdenver.edu/docs/librariesprovider279/teaching-documents/attendance-considerations.pdf>  
   
Mask Enforcement Support:  
<https://www.ucdenver.edu/docs/default-source/safereturntocampus/classroom-management.pdf>  
   
Center for Excellence in Teaching and Learning:  
<https://www.ucdenver.edu/centers/cetl>  
   
Office of Information Technology:  
<https://www.ucdenver.edu/offices/office-of-information-technology>  
  
Learning Commons:  
<https://www.ucdenver.edu/housing-and-dining/city-heights/learning-commons>  
   
Lynx Central Health and Wellness:  
<https://www.ucdenver.edu/student/health-wellness>  
   
Early Action:  
<https://www1.ucdenver.edu/offices/provost/student-success-initiatives/early-action>