UNIVERSITY OF MARYLAND, College Park

Spring 2021 Physics 274: Mathematical Methods for Physics I Prof. B L Hu

Description: This course is the first of a two semester sequence (274-373) on mathematical methods for physics intended for physics majors and those desiring a rigorous preparation in the physical sciences. Topics include linear algebra, curvilinear coordinates, vector analysis and Dirac functions.
Prerequisites: PHYS272 and MATH241. http://www.ugst.umd.edu/courserelatedpolicies.html

Lectures: MWF 2:00pm - 2:50pm, Online Zoom through ELMS 1st lecture Jan 25.
Lecturer: **Prof. B. L. Hu**, Office: PSC3153, Phone: (301) 405-6029, Email: blhu@umd.edu Office hours: Please email me for an appointment, easily before or after class, or have individual discussion via Skype.
TA: Office: Office hours:. Communication via ELMS or email: Cell phone: for matters of urgency only.

Textbooks:
Required: Mary L. Boas, Mathematical Methods in the Physical Sciences, 3e (Wiley 2006)
Errata: Corrections and Minor Revisions of Mathematical Methods in the ...
R. Snieder and K. van Wijk, *A Guided Tour of Mathematical Methods for the Physical Sciences* 3rd ed (Cambridge University Press 2015) I shall provide you with the pdf files of those chapters we will use.
Recommended:
Spiegel, Lipschutz and Spellman, *Vector Analysis 2nd* ed Schaum's Outlines (many examples) inexpensive.
Lay Lay & McDonald, *Linear Algebra and Its Applications* 6th ed (Pearson 2021) useful for some topics.
Alexander Altland and Jan von Delft, Mathematics for Physicists: Introductory Concepts and Methods 1st Edition (Cambridge University Press, 2019) Not expensive and worth owning as reference. If ours were a 300/400 level mathematical physics course I might have chosen this as our required textbook because the treatment is more sophisticated using modern concepts and methodology. E.g., the parts on differential forms and differential geometry would serve as a good preparation for General Relativity in Phys.475.

Reading: The main subjects and the approximate progression of topics are listed in the Course Contents below. Readings of specific sections in the textbooks will be announced in class as we progress. To enhance your comprehension of a particular subject to be covered in class, *try to read the material in the textbooks before coming to the lecture*. This will enable you to ask questions about ideas you may not grasp fully on a first reading and to gain a better overall perspective. Read it again after the lecture, study the examples and do the assigned problems. I encourage questions in class (to the extent time permitting, but that can be followed up in my office hours) – this could stimulate thoughts and discussions.

Course webpage: Please check for new announcements, adjustment of topics or due dates in the course website at ELMS/CANVAS system: www.elms.umd.edu/page/student-support where you will also be able to access your exam grades. For questions call the Help Desk at 301.405.1500 or email elms@umd.edu.

Homework: 10 sets of homework problems are planned. They are to be worked out and handed in at the beginning of classes on the due dates -- check the course webpage for last minute changes. Solutions will be posted soon after, thus no late homework will be accepted. If uncontrollable situations delays you and you want to hand in your homework after the due date, please seek my approval with a good reason.
Grading scheme : Each homework has 5 problems worth a total of 20 HW pts: 1 problem worth 8 points will be selected to be graded in detail. Each of the remaining 4 problems is worth 3 points. The best 8 sets are counted toward a total of 160 points toward the course score.

I encourage group discussions but stress strongly **the importance of thinking through and working out the problems on your own**. *Don't rely on others' help or just passively read the solutions.* Homework is essential to your mastering a subject and the effort you put in to it will be reflected clearly in your examination performance.

Note: Copying solutions from any source **is considered as plagiarism,** a form of academic dishonesty. This includes also partial consultation of published solutions. See University policy below for consequences. This act can easily be detected by an experienced eye. More importantly, doing so will rid yourself of the precious experience of *learning through thinking and retaining through practice*. **It will**

definitely hurt your performance in examinations. Thus, treat each homework as an open book exam and refuse help from anyone or any other sources. Discipline yourself in this routine. You will see the progress. After you have handed in your homework, make sure you *use the posted solutions to check on what you did wrong, rework those problems till you get them right.* Make this a habit.

Mid-Term Exams: Two 50-minute closed book mid-term exams **via Zoom** are scheduled on **Friday March 12** and **Friday April 9** during the lecture periods. They are likely to contain one or more problems based on the assigned homework problems. Each exam counts 100 points.

In lieu of the final exam, to lessen your stress, **Exam 3** will be held in class on **Monday, May 10 @ 2:00-2:50pm via Zoom**, just like Exam 1 & 2**.** Worth 100 points, it will cover only materials on vector analysis.

Please make all necessary preparations and arrangements to ensure you can take these three exams because no make-up exam will be given.

Exams are meant to test your understanding and ability to apply concepts covered in the course, not how well you can memorize the formulas or course materials. You may bring to each exam one 8.5x11" page (one side only) of useful formulas. **No derivations --** If you do so and if an exam problem asks for such derivations, you will get zero points for it, an unworthy loss. The values of constants and useful integrals will be provided. Further details about online exam protocols will be given before an exam.

Academic dishonesty is a serious violation and will be dealt with strictly, according to University policy.

Course Grade: Your course grade is based on the total course score (max 460) made up in the composition of 160 points homework, 200 points for the 2 mid-term exams, and 100 points from your final exam scores.

8 best Homework sets out of 10 sets	160 points
2 Midterm Exams	200 points
1 Final Exam	100 points
Total Course Score:	460 points

Academic Integrity: *The university has approved a code of academic integrity available on the web. The code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents, or forging signatures. The university senate requires that students include the following signed statement on each examination or assignment: I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment). Compliance with the code is administered by a student honor council, which strives to promote a community of trust on the College Park campus. Allegations of academic dishonesty may be reported directly to the honor council (301-314-9154) by any member of the campus community.*

Course Contents: **FUN to LEARN. WELCOME!**

Linear Algebra (~ 8-9 weeks) Mainly Boas, supplemented by Lay et al
Linear vector spaces; linear operators and their representation as matrices; matrix algebra; determinants and their applications to the solution of linear inhomogeneous equations; inner products; eigenvalues and eigenfunctions with applications to physics problems; infinite dimensional vector spaces.

Curvilinear Coordinates and Vector Analysis (~ 4 weeks) Mainly Snieder, supplemented by Spiegel.
Curvilinear orthogonal coordinates; cylindrical and spherical coordinate systems; gradients, divergences and curls in curvilinear coordinates and their geometrical interpretation, with examples from physical systems; Gauss's and Stoke's theorems. Laplacian and wave operators.

Dirac Delta Functions (~4 lectures)
Properties of the delta function; delta function of a function; delta functions in more than one dimension.
[Susan Lea, *Mathematics for Physicists* (Thomson 2004) Chapter 6 has more details on this topic]