

PHYS 3160 Topics and Methods of Theoretical Physics II

Course Syllabus

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Office hours For outside classroom discussion you can see me during office hours: MF 11:05am-12:20pm, TR 01:40-02:40pm or *by appointment*.

Text **Mathematical Methods in the Physical Sciences** (3rd Edition) by Mary L. Boas, John Wiley & Sons (2006)

Lecture note: <http://www.mtsu.edu/faculty/derenso/docs/Theoretical-Physics-I/Lecture-Note/Theo-Phys-I-Math-Methods.pdf>

Purpose To provide the physics and natural science, engineering, or mathematics majors with the mathematical tools needed to solve problems in the advanced physical sciences (physics, astronomy, chemistry, and engineering). The emphasis will be on applications of the mathematical techniques being studied to problems in physics (in particular, classical mechanics, electromagnetic theory, and quantum mechanics). For the tentative complete list of topics that will be covered please refer to the table at the last page

Grading The course grade will be determined by your performance on the homework assignments and the exams.

Homework	30%	Grade	A	B⁺	B	B⁻	C⁺	C	C⁻	D⁺	D	D⁻	F is
Midterm exam	35%												
Final Exam	35%	Min Score	90	87	83	80	77	73	70	67	63	60	< 60

Participation & grading The grading scale is fixed. However, there will be additional 0-4 points that will be added to your final score depending on your full attendance (that also include coming to class on time) and active participation in class. There will be an attendance sheet that you need to sign on at the beginning of each class.

Homework There will be a weekly homework assignment. Homework assignments will be distributed in class or posted on the course. Each homework assignment consists of at least five problems. These problems primarily be selected from your textbook, in some cases, with some modifications. It may also include problems outside from the textbook some of which I would make up. Among these problems, **two would be mandatory. I will grade all the problems you worked out and turned in. Working out all the problems including the none mandatory ones contributes to the extra 0-4 points that will be added in your final average score.** Therefore, it is for your own advantage to solve all the problems in each homework assignment. Each homework assignment (the two mandatory problems) will receive a maximum of hundred points. The lowest homework score will be dropped. Solutions will be posted on the course website for each homework assignment. Here, I list some ingredients that make a homework useful to you and also easy to read and grade for me:

- Work out the details and fully explain your line of reasoning. This is the only way to fully test and show your understanding of the technicalities and of the concepts.
- Highlight your final results.
- Always check that the final result makes sense physically, i.e. whether it has the correct physical units and, if it is a numerical result, the correct order of magnitude.
- The solution of each problem must be presented according to the order assigned in the homework. You must also begin the solution to each problem on a new page. **Never use the back pages!**
- You must turn the complete solutions of each homework assignment along with the cover page.

If the steps of the solution of a problem are not readable, credit will not be given although the final

result seems to be right.

In addition to the regular problem sets, I may list additional optional problems or some links to other sources of problems, some with solutions –Doing problems is the best way to learn mathematics or physics and be able to develop great analytical skills that you will need in tackling physical or none physical problems in the universe.

Due date: Homework assignments are due at the beginning of class one week after it is assigned. No mercy will be granted on the due date and time. Remember, I give partial credit, so the last 10 minutes of work will not make much difference.

Late policy: I accept problem sets up to three days late from the due date for 50% credit, and after that not at all. You may turn in part on time and part late. Please make a note in the space provided on the problem set cover page if it is being split this way. You do not need to contact me to turn in a problem set late at 50% credit, or to turn in part on time and part late.

Extensions: You will have one full-credit one-week extension for this semester. No need to contact me just write it on your problem set cover page. Otherwise, extensions are granted for good reasons only- physical or mental health issues, family emergency, etc. You must contact me before the homework due date and you must provide some sort of proof (e.g., note from health center, counseling center, etc...). A heavy amount of other coursework is not sufficient reason for an extension (though you may use your free extension in such circumstances - *so save it until you really need it!*).

Solutions: I will post the solution sets to each HW assignment on the course website. I return Graded problem sets to you in class *roughly* one week after they are due. If you are absent, you must pick it from my office within a week. After a week, you will not be able to get it as I often recycle unwanted papers. You should keep a copy of your homework sets so you can review them with the solutions.

Collaboration: I permit collaboration on homework assignment, but each student's solution must be the result of his or her own understanding of the material. You must use collaboration work carefully. If you rely on your colleagues too much, you will do poorly in the fixed-time, independent in class exam environment. I have observed that students with good exam scores tend to have done well on homework, but that good homework scores do not predict good exam scores.

Mathematical software: I do not allow use of mathematical software like Mathematica, as this is a course where you are learning the mathematical methods you need in advanced physics courses.

Exams There will be a midterm and a final exams each worth 35% and has in-class and take-home portions. The take home portion for the midterm exam will be distributed one week before the in class exam (**February 26, 2020**) and it will be due on the day of the in-class portion exam (**March 04, 2020**). The final exam would be comprehensive. The take-home portion will be handed in class on **Wednesday, April 29, 2020** and is due at the beginning of the in-class portion exam, which will be on **Monday, May 4, 2020 (12:30 - 2:30 p.m.)**. All in class exams will be closed book.

Dropping It is the policy of the Department of Physics & Astronomy that no drops will be approved after the deadline posted in the university's course Schedule Book. The deadline for dropping *without a grade* for this semester is **February 03, 2020**. Deadline for students to drop a course with a grade of "W" is **March 29, 2020**.

Disabilities If you have a disability that requires assistance or accommodation, or if you have questions related to any accommodations for testing, note takers, readers, etc, please speak with me as soon as possible. Students may also contact the Office of Disabled Students Services (898-2738) with questions about services.

Lottery Scholarship To retain Tennessee Education Lottery Scholarship eligibility, you must earn a cumulative TELS GPA of 2.75 after 24 and 48 attempted hours and a cumulative TELS GPA of 3.0 thereafter. You may qualify with a 2.75 cumulative GPA after 72 attempted hours (and subsequent semesters), if you are enrolled full-time and maintain a semester GPA of at least 3.0. A grade of C, D, F, or I in this class may negatively impact TELS

eligibility. Dropping a class after 14 days may also impact eligibility; if you withdraw from this class and it results in an enrollment status of less than full time, you may lose eligibility for your lottery scholarship. Lottery recipients are eligible to receive the scholarship for a maximum of five years from the date of initial enrollment, or until a bachelor degree is earned. For additional Lottery rules, please refer to your Lottery Statement of Understanding form (<http://www.mtsu.edu/nancial-aid/forms/LOTFOD.pdf>) or contact your MT One Stop Enrollment Counsel or (<http://www.mtsu.edu/one-stop/counselor.php>).

Academic Honesty

Academic misconduct will not be tolerated in the Department of Physics and Astronomy. Offenses include, but are not limited to: Plagiarism, Cheating, Fabrication, and Facilitation. Instances of academic misconduct will, at a minimum, result in a zero for the assignment in question, followed by submission of a formal complaint to the Office of Judicial Affairs. If signs of cheating are detected or observed, all parties involved (copiers and facilitators) will receive a grade of zero and be included in the report. There will be no exceptions, all instances will be reported. Details regarding MTSU and TBR policy, including definitions for the offenses listed above, are available at http://www.mtsu.edu/juda_/integrity.php.

IX Statements

1. Students who believe they have been harassed, discriminated against or been the victim of sexual assault, dating violence, domestic violence or stalking should contact a Title IX/Deputy Coordinator at 615-898-2185 or 615-898-2750 for assistance or review MTSU's Title IX website for resources. <http://www.mtsu.edu/titleix/>
2. MTSU faculty are concerned about the well-being and development of our students and are legally obligated to share reports of sexual assault, dating violence, domestic violence and stalking with the University's Title IX coordinator to help ensure student's safety and welfare. Please refer to MTSU's Title IX site for contact information and details. <http://www.mtsu.edu/titleix/>

L	Day	Date	Topics according in my lecture note	Topics in the textbook
			Chapter 9: Introduction to Calculus of Variations	Chapter 9: Sections 1-5
1	W	22 JAN	Introduction to the Calculus of Variations	
2	M	27 JAN	The Brachystochrone Problem; Lagrange's Equations	
			Chapter 10: Introduction to Eigenvalue problem	Chapter 3: Sections 11,12
3	W	29 JAN	A Matrix Review; The Eigenvalue Problem	
4	M	03 FEB	Eigenvalues and Eigenvectors: Applications	
			Chapter 11: Special Functions:	Chapter 11: Sections 1-12
5	W	05 FEB	The Gamma, Beta, Error, Dirac delta Functions	
6	M	10 FEB	Stirling's Formula and Elliptic Integrals	
			Chapter 12: Solutions to Differential Equations: Power Series method	Chapter 12: Sections 1-22
7	W	12 FEB	Introduction: Complete and Orthogonal Sets of Functions	
8	M	17 FEB	The Legendre differential equation and the Legendre Polynomials	
9	W	19 FEB	Potential Problems and the Generating Function for Legendre Polynomials	
10	M	24 FEB	Expansions using Legendre Polynomials; Spherical Harmonics	
11	W	26 FEB	The Addition Theorem for Spherical Harmonics <i>Take-home part of the midterm exam will be distributed in class.</i>	
12	M	02 MAR	<i>The Method of Frobenius; Bessel's Equation and Bessel Functions; An Application;</i>	
13	W	04 MAR	<i>In class Midterm Exam</i>	
			March 9-14, Spring Break No Classes	
14	M	16 MAR	The Orthogonality and Normalization of Bessel Functions	
			Chapter 13: Partial Differential Equations	Chapter 13: Sections 1-8
15	W	18 MAR	Introduction to Partial Differential Equations and the Separation of Variables	
16	M	23 MAR	Laplace's Equation in Cylindrical Coordinates	
17	W	25 MAR	Laplace's Equation in Spherical Coordinates	
18	M	30 MAR	Poisson's Equation	
			Chapter 14: Function of complex variables	Chapter 14: Sections 1-10
19	W	01 APR	Analytic Functions	
20	M	06 APR	Contour Integration and Cauchy's Theorem	
21	W	08 APR	Residues and the Residue Theorem	
22	M	13 APR	Applications of the Residue Theorem: The Kramers-Kronig Relations	
			Chapter 15: Fourier series and Transform	Chapter 07: Sections 1-12
23	W	15 APR	Introduction to the Series and Fourier Transform	
24	M	20 APR	Application of the Fourier Transform: The Heisenberg Uncertainty Principle	
			Chapter 16: Laplace Transform	Chapter 08: Sections 8-9
25	W	22 APR	Introduction to Integral Transforms and the Laplace Transform	
26	M	27 APR	Applications of the Laplace Transform <i>Take-home part of the final exam will be distributed in class</i>	
27	W	29 APR	<i>Reserved for...</i>	