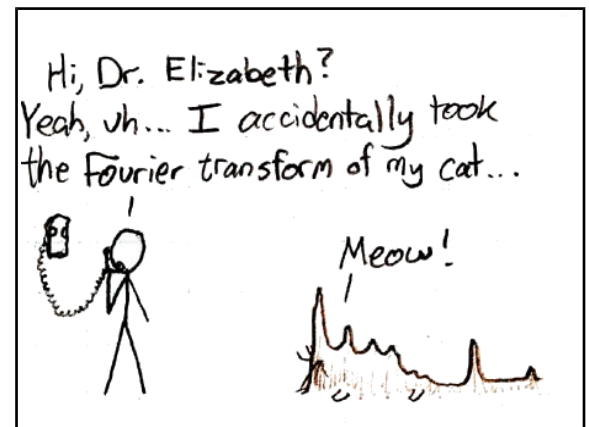


# MA/PY 370 Mathematical Methods for the Physical Sciences I

Instructor: Lia Vas, Ph.D.



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**Office Hours:** Monday 12-1, Thursday 3-5, Friday 12-1 (no appointment necessary). Feel free to make an appointment if you cannot come to my regular office hours.

**Text:** NO TEXTBOOK REQUIRED. Handouts with new material and practice problems will be distributed for each teaching unit. The textbooks used for the class preparation include the following.

- Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 3rd edition, 2006.
- Calculus, J. Stewart, Brooks/Cole Publishing Company, 7<sup>th</sup> edition, 2011.
- Symmetry and Structure, S.F.A. Kettle, John Wiley & Sons, 1986.

**Topics covered:**

1. Line and surface integrals, flux, Stokes' and Divergence Theorems
2. Complex functions and complex integrals
3. Fourier Series Fourier Transform
4. Series solutions of ordinary differential equations
5. Groups, Symmetry Groups of Molecules, intro to Group Representations

**Tentative Schedule:**

- Exam 1. During week 4 (2/9)    Exam 2. During week 7 (3/2)
- Exam 3. During week 11 (4/6)    Exam 4. During the finals week



**Grading:**

4 Assignments	12%
Exams 1-3	18% each
Exam 4	22%
Project	12%
<b>TOTAL</b>	<b>100%</b>



Grades are computed according to the following system:

letter grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
number grade	97 to 100	93 to 96	90 to 92	87 to 89	83 to 86	80 to 82	77 to 79	73 to 76	70 to 72	67 to 69	63 to 66	60 to 62	0 to 59

## **Relevant Course Elements.**

**Number of credits:** 3

**Prerequisites:** PY212 and MA222 (or MA202) or the permission of instructor.

**Attendance:** It is imperative that students attend all classes. Students are responsible for all material covered in class, even if attendance is not checked or assignments collected.

**Exams, assignments and project:** There will be **four assignments** during the semester and one **student project** concentrated on applications of mathematics to physics or proofs in mathematics. Assignments turned in after their due date will receive an automatic reduction in grade. No assignment grade will be dropped. Sample project topics will be distributed. There will be **four exams**. No makeup exam will be given unless the excuse for missing the scheduled exam is acceptable to the instructor. Any makeup exam must be taken **before** the next regularly scheduled exam. No exam grade will be dropped.

**Response time:** The assignments, projects and exams are typically graded in three days after they are turned in. Special circumstances like snow days, school closing or holidays, may occasionally delay the response time. Barring special circumstances, students' emails are usually responded to within one working day.

### **More on the topics:**

- **Fourier Series and Transform.** Students will learn about the Fourier transform and its use in nuclear magnetic resonance and signal processing.
- **Complex numbers, contour integrals, residues, Divergence and Stokes theorems.** These topics represent basics for numerous and widespread applications.
- **Series solutions of ODEs** covers a method of finding solutions of ODE with nonconstant coefficients that appear in physics applications.
- **Groups and Symmetries of Molecules.** Group theory is a powerful mathematical theory used in physics and chemistry, in particular quantum mechanics, crystallography and spectroscopy. Students will learn the mathematical definition of a group, basics of the theory of finite groups and point groups and their applications.

Whenever possible, these mathematical topics will be related to specific problems in various areas of physics and physical science. For students interested in continuing their education at a graduate level, the course presents some **mathematical techniques** that certain graduate programs in physics, chemistry and engineering use. The course emphasizes **general ideas**, not just mastering various techniques or methods. The underlying theme behind most course topics (Fourier Transform, Groups and Symmetries and Series Solutions) is that it might be easier to solve a certain problem by translating it to a different set up, solve it there and then translate the solution back into the original setting. This general principle of problem solving is often used in various fields and will be a useful concept for the students to acquire.

### **Course Objectives.**

- Use the mathematical methods to develop strategies to solve real world physics and physical science problems.
- Develop mathematical models from physical principles, solve problems using of mathematical techniques covered in the course and verify the validity of the solutions obtained.
- Present the findings in a form of a written report.

### **Learning outcomes.** Students will:

- acquire knowledge of various mathematical concepts and techniques required for successful application of mathematics in physics and related sciences.
- be able to model data using the language and techniques of mathematics.
- be able to understand and solve multidisciplinary application problems using mathematical methods.
- demonstrate ability to cover a topic independently and present their results in a written report.

**Academic integrity:** Academic integrity is at the center of the educational experience at USciences.

Students are therefore expected to uphold the highest standards of academic integrity and not engage in or tolerate academic dishonesty. Academic dishonesty includes, but is not limited to, fabrication, cheating or plagiarism, and unauthorized collaboration. Any violation of academic integrity will be investigated and, where warranted, the student will receive appropriate sanctions through the University's Student Conduct Process. Please familiarize yourself with the current USciences Student Handbook. Adherence to the Student Conduct Policy and Academic Integrity Policy will help to ensure that your learning and living experiences are founded on integrity.

**Americans with Disabilities Act (ADA) Compliance Statement:** USciences supports the educational endeavors of all students, including students with disabilities. ADA defines a disability as a mental or physical impairment that substantially limits one or more major life activities. If you believe that you have a disability that may impact your ability to fulfill your course or degree requirements, and you would like more information on applying for an accommodation under ADA, please contact the Administrator of Student Accommodations at 215-596-8758.

**Mental Health Wellness Statement:** USciences encourages students to recognize that academic success requires students to be emotionally and physically well. If you are having difficulty coping with stress associated with the classroom or are experiencing other personal issues, please go to USciences Health and Counseling (SHAC) located on the first floor of Whitecar Hall or call 215.596.8536. Additional emotional support is available 24/7 and can be obtained by contacting the National Suicide Prevention Hotline at 800.273.8255 or by texting "Go" to the Crisis Text Line 741-741. The services listed above are all free and confidential.