SYLLABUS

MATHEMATICAL METHODS FOR THE PHYSICAL SCIENCES

SPRING SEMESTER 2017

http://www.phys.uconn.edu/~rozman/Courses/P2400_17S/

Last modified: April 21, 2017

Course description: Physics 2400 *Mathematical Methods for the Physical Sciences* covers the basic mathematical tools used in sciences and engineering: complex analysis, ordinary and partial differential equations, integral transforms, asymptotic expansions, and special functions. The course introduces Computer Algebra Systems (as analytic calculators) and encourages the use computerized typesetting (as used by physicists and mathematicians for professional publications).

The goal of this course is to give an introduction to mathematical methods for solving hard mathematics problems that arise in the sciences. The approach requires a combination of "real" mathematics, skill in making legitimate approximations, and intelligent use of computers to get some motivation and verify the approximations. We will start with assorted tools of the trade and simple problems (simple integrals, simple differential equations, etc.) and progress toward more challenging topics.

Lectures: TuTh 5:00 – 6:15, P121, Physics Building

Course webpage: http://www.phys.uconn.edu/~rozman/Courses/P2400_17S/

Instructor: Michael Rozman

email:	rozman@phys.uconn.edu
phone:	860 486 5827
office:	P327, Physics Building
office hours:	TuTh 4:00 PM – 5:00 PM in P122, and by appointments

Optional textbook(s):

- Lorella M. Jones, *Introduction to Mathematical Methods of Physics*, Benjamin/Cummings, 1979 (out of print; copies of the relevant sections will be provided)
- Sanjoy Mahajan, *Street-Fighting Mathematics: The Art of Educated Guessing and Opportunistic Problem Solving*, MIT Press, 2010 (available online from the publisher, free)

Communications: talking in person is the preferred method to contact the instructor; email is the next best option.

- please include the tag *"[phys2400]"* (without quotes, no spaces) in the subject of your email, e.g. "[phys2400] midterm II retake"
- please no emails with attachments unless requested by the instructor. Use *UConn File DropBox* https://dropbox.uconn.edu/dropbox or *UConn FileLocker* http://web2.uconn.edu/filelocker/ for submitting large files

Homework: Homework assignments

Homework assignments submitted before or on the due date may be returned for corrections after initial grading.

Homework assignments are not accepted after the solitions had been discussed in class and/or had been posted online. Individual emergencies potentially can be accomodated by extra credit assignments.

You are welcome to discuss the homework's problems with others in order to better understand them but the work you turn in must be your own. In particular, you must run your own calculations (where applicable) and communicate and explain the results in your own words.

Assignments that are hard to understand are also hard to grade properly, therefore: (a) use words and pictures to supplement your equations; (b) work must progress

linearly down the page – recopy solutions that are too nonlinear.

Requirements for acceptable written assignments:

- Use letter-size paper. Use only one side of each sheet.
- Box your final answer(s).
- Staple your notes together, (i.e. no paper clips, torn or folded corners) with the assignment cover page (if applicable).

Highly recommended: make copies of homework assignments for your own files. (A copy machine is in the main physics office. It is available for you for free.)

Honors conversion: Students interested in honors conversion should contact the instructor during *the first week of classes*.

Exams: Two midterm exams and a *cumulative* final exam

Course project(s): may be assigned as a partial or full replacement of the exams

Use of LaTeX is strongly encouraged. Extra points will be assigned for homework prepared in LaTeX

Grading scheme: The course grade will be calculated using the following scheme.

Homework	40%
Midterms	30%
Final exam	25%
Class participation	5%

Class schedule: This is a *preliminary* schedule. The midterm date(s) will not change. The material will be covered in roughly the order listed. However we may spend slightly more or less time on certain topics than it is listed below.

Week(s)	Subject
1-2	Simple tools: Gaussian integrals; Euler's formula; Gamma function, $\Gamma(x)$, Beta function $B(x,y)$; differentiation with respect to a parameter for evaluation of integrals and sums; Leibniz's formula.
3-6	Complex analysis for physicists.
	Midterm I - Thu, March 3
7-8	Asymptotic expansion of integrals and sums
9	**Spring Break**
10	Asymptotic expansion of integrals and sums
11	Integral transforms
	Midterm II
12	Perturbation methods
13-15	Approximate solution of differential equations

Recommended reading:

- Carl Bender and Steven Orszag, *Advanced Mathematical Methods for Scientists and Engineers*, Springer Verlag, 1999
- Hung Cheng, *Advanced Analytic Methods in Applied Mathematics, Science, and Engineering*, Luban Press, 2006
- Homer Reid, Advanced Analytical Methods in Science and Engineering, MIT 18.305, 2015
- Michael Brenner, Physical Mathematics, Harvard AM201, 2010