PHY 280: Mathematical Methods for Physicists
Spring 2008

Professor: Mark McKibben
Office: Hoffberger Science 122
Office Hour: Varies daily – see posted schedule
Phone: 410-337-6281
Email: mmckibben@goucher.edu

Textbook: Mathematical Methods in the Physical Sciences, 3rd edition, by Mary L. Boas, J. Wiley and Sons, Inc.

Other useful books available in Julia Rogers library:

- Weber & Arfken: *"Essential Mathematical Methods for Physicists"*, Elsevier, 2004
- Chow: *"Mathematical Methods for Physicists-A Concise Introduction"*, Cambridge University Press, 2000
- Mahan: *"Applied Mathematics"*, Kluwer Academic, 2001
- Seaborn: *"Mathematics for the Physical Sciences"*, Springer 2001
- Snieder: *"A guided tour of mathematical methods for the physical sciences"*, Cambridge University Press, 2001

Course Content:

Physics 280 is the one-semester course intended for a student who has completed at least multivariable calculus who wants to develop, in a short time, a basic competence in each of many areas of mathematics needed in junior and senior (and graduate) courses in physics, chemistry and engineering. It is also designed for more advanced students, who have taken Linear Algebra and/or Differential Equations in the past, to review some topics and find a way to apply them to relevant problems in the physical sciences. This course is not designed to replace any mathematics courses since the focus is not on a rigorous mathematical development of the material, although some contextual motivation will be provided as the material is developed as to not make it appear to have "magically developed". Rather, the intention is to hone the mathematical skills needed for advanced physics and chemistry courses. A significant amount of time will be spent in developing problem solving strategies which are necessary in learning and understanding physics and chemistry principles. The computer laboratory work using the symbolic/ numerical/graphical package MAPLE will be incorporated in the course in the way of several projects covering each main topic of the course.

The main topics addressed in this course are as follows:

- **Vector Analysis** (including a discussion of vector fields, line integrals, and surface integrals)
- **Complex Analysis** (including elementary complex-valued functions, properties of analytic functions, contour integration, Cauchy integral formula, Laurent series, and residue calculus)
- **Fourier Analysis**
- **Ordinary Differential Equations** (only specific classes of ODEs will be discussed, including linear equations, separable equations, second-order ODEs with constant coefficients, pendulum equation, spring-mass systems, and Frobenius method)
- **Special Functions** (Gamma and Beta functions and their properties, Bessel functions, and Legendre polynomials)
- **Partial Differential Equations** (Basic techniques involved in solving heat, wave, and diffusion equations in Cartesian, cylindrical, and spherical coordinates)

Course Format:

The course will be taught primarily using an interactive-lecture style, meaning that I will present the topics in class and quite frequently request from the audience suggestions as to how to proceed in a given discussion. You are encouraged to pose questions at any time in class. The mathematics will, at times, become somewhat involved. So, I rely on your feedback to make certain you are "on target." As a common courtesy, if you intend to miss class for any reason, please inform me at least the day before you are going to be absent. Keep in mind that obtaining any announcements, changes in assignments, class notes, etc. is your sole responsibility. **Late assignments will NOT be accepted except under very extreme circumstances that can be documented (e.g., "I had to go home for the weekend." and "I have been so busy lately." are not valid excuses.).**

Assessment:

- **Collected Problem Sets:** Problem sets will be assigned daily and will be collected for grade. Your solutions should be professional looking and all reasoning should be logical and clear. You may discuss the underlying mathematical principles used in the homework, but each student must submit his or her own solutions - do not submit identical copies of a given assignment.

- **Maple Labs:** Maple labs, some of which are quick and others of which are extensive, will be assigned as we cover the appropriate material in the class. These lab activities are every bit as important as the collected work! You may complete these labs in pairs (of TWO students, no more). If you choose to do so, you must make certain that both persons understand the material completely, as there will be a Maple Practical Exam at the end of the semester which will be completed individually in class.

- **Take-Home Exams:** There will be two take-home exams covering the mathematics from the first 5-6 weeks, and then from the 7^{th} – 12^{th} weeks. You may not consult other students, books, notes, or related material when completing this exam unless otherwise instructed.

- **Two-part Final Exam:** The final exam will be given in two distinct parts. One part is a two-hour in-class comprehensive exam covering the mathematical techniques and ideas from the entire semester; this exam will occur during the usual final exam period. The second part is a Maple practical exam, and will be scheduled individually with me in the lab – you will be given problems of the sort you explored in the Maple labs throughout the semester and will be given two hours to complete them on Maple. You may access your Maple code and homeworks in the completion of this exam, but the two-hour limit will be strictly enforced, thereby requiring you to be familiar with how to use the code to complete the problems.

Grading Scheme:

- Collected Problem Sets: 25%
- Maple Labs: 10%
- Take-Home Exam 1 15%
- Take-Home Exam 2 15%
- Final Exam – Maple practical 15%
- Final Exam – In-class portion 20%

Grading Scale:

The following is an approximate grading scale. I will never demand higher percentages than those listed to earn a certain grade.

A, A-	90 – 100	**P**	70 – 100
B+, B, B-	80 – 89	**NP**	0 – 69
C+, C, C-	70 – 79		
D+, D, D-	60 – 69		
F	0 – 59		

Plusses and minuses shall be assigned depending on individual performance, as warranted.

Goucher College Honor Code: Every student is bound to the Goucher College Honor Code, which is easily accessible on the Goucher website and in the student handbook. Any perceived cheating or other violation of this code will be dealt with swiftly and severely.