# Physics 116A

## Mathematical Methods

**Instructor**: Peter Young (office ISB 212, phone 459-4151, e-mail: petery@ucsc.edu)

**Place**: Nat. Sci. Annex 101.

**Time**: Mondays, Wednesdays and Fridays, 11:00–12:10 pm.

**Note**: Course materials, such as homework assignments, homework solutions, and handouts will be available at my web site

http://young.physics.ucsc.edu/116A/

### Books

The recommended book for the course is

- **Mathematical Methods in the Physical Sciences** by M. Boas

Other useful books (available on reserve in the science library) are

- *Mathematical Methods for Scientists and Engineers* by D. A. McQuarrie.
- *Mathematical Methods for Physics and Engineering* by K. F. Riley, M. P. Hobson, and S. J. Bence,
- *Essential Mathematical Methods for Physicists* by H. J. Weber and G. Arfken.
- *Basic training in mathematics: a fitness program for science students* by R. Shankar.

There are also web sites which give problems and solutions. One of these is http://exampleproblems.com/wiki/index.php/Main_Page.

### Approximate course schedule

This is the first course of a three-quarter sequence, at the end of which you should have a good knowledge of *all* the material in Boas' book.

| Topic | Lecture dates | Readings |
|---|---|---|
| Infinite series, power series | Jan 6, 8, 10, 13 | Boas Ch. 1 |
| Complex numbers, complex functions and complex infinite series | Jan 15, 17, 22 | Boas Ch. 2 |
| Special functions defined by integrals, and asymptotic expansions | Jan 24, 27, 29, 31, Feb 3 | Boas Ch. 11 |
| Matrices, linear algebra and vector spaces | Feb 5, 7, 12, 14, 19, 21, 24, 26 | Boas Secs. 3.1–3.10 |
| Eigenvalue problems and matrix diagonalization | Feb 26, 28, Mar 3, 5 | Boas Secs. 3.11–3.12 |
| Tensor analysis | Mar 7, 10, 12, 14 | Boas Secs. 10.1–10.6 and handout |
| Review | Mar 17 | |

In the lectures I aim to cover the main points for each topic, but will not always cover every detail in the book. Nonetheless, I expect you to know *all* the material in the book. Hence it is important that you read each relevant section of the book, preferably before the lecture covering it. I also expect you to be familiar with the material in the handouts that I will provide.

**Recording of the lectures**
The lectures will be recorded and can be viewed at `http://webcast.ucsc.edu`.

**Grading**
Your performance in the class will be decided on the basis of the midterm, final, and homework assignments as follows:

| | |
|---|---|
| midterm (Feb. 10, in class) | 30% |
| final (March 20, 12:00–3:00 pm) | 50% |
| homework | 20% |

The midterm and final exams will be closed book. You will be allowed to bring one sheet of hand written notes if you wish. To pass the class you *must* take the final exam and get a satisfactory score in it.

**Prerequisites**
Physics 5A/L, 5B/M, 5C/N; Mathematics 23A and 23B (multivariable calculus)

**Homework**
There will be nine homework assignments. These will be handed out each Friday and due back the following Friday. It is very important to work hard on the homework problems. You don't really understand a topic until you are able to solve problems in it. The way to learn how to solve problems is through *practice*. You are encouraged to discuss the homework problems with other students. You are also encouraged to attend the discussion section and office hours for additional help, either with problems or bookwork.
To get credit for your homework and exams, *you must show your working*. Simply writing down the answer will not do.

**Homework and Exam Solutions**
Solutions to the homeworks will be posted on the class website shortly after the deadline for handing them in. Solutions to the exams will be posted after the exams have been completed. A password is required to view the solutions. This will be announced in class.

**Computer Algebra Systems**
The two best known computer algebra systems are *Mathematica* and *Maple*. Student versions of these are available for about the cost of a typical (unfortunately that means expensive!) textbook. Alternatively, you can use Mathematica for free at several of the computer labs on campus.
You need to be able to solve the problems yourself but a computer algebra program can be very useful for *checking* your answers. I recommend you do this, though it is not mandatory.

**Exams**
The exam times are:

| | |
|---|---|
| Midterm: | Monday February 10, in class. |
| Final: | Thursday, March 20 12:00–3:00 p.m. |

Exams are closed book, but you can bring one sheet of (hand-written) notes if you wish. No calculators or other electronic devices are allowed. Cell phones must be switched off. To get credit *you must show your working.*

**Discussion Section**

The TA is Adam Coogan, email: acoogan@ucsc.edu, office ISB 314 (the "$\pi$" office). There are two discussion sections. These are on Tuesdays, 4:00–5:10 pm in Baskin 372, and Wednesdays 5:00-6:10 pm in Physical Sciences 110. Discussion sections will start the first week.

**Office Hours**

- TA, Adam Coogan, Thursdays, 1:00–2:00 pm, ISB 314.
- Myself, Thursdays 2:00–3:00 pm, ISB 212