Instructor: Prof. John F. C. Wardle  
e-mail: wardle@brandeis.edu  
Phone: 6-2889  
Office: Abelson 328

Class hours: M, W, Th 12:00 – 12:50  
Classroom: TBA

Recitation section: There will be at least one evening recitation section. Details TBA

Graduate Teaching Fellow: TBA  
Undergraduate TA: TBA

My Office hours: M, W, Th 11-12, or by appointment, or drop by – I am here nearly all the time. I expect you all to make use of my office hours. They are not just for people having difficulties with the course; they are for everyone interested in learning physics.

Goals: This course is the transition from first year physics courses to the sequence of courses that leads to majoring in physics. The immediate goal is to teach the mathematical and physical background needed for PHYS 20b (Quantum Theory I), PHYS 30a (Electromagnetism) and PHYS 31b (Quantum Theory II). But oscillations, vibrations and waves permeate all of physics from solids to string theory and gravitational radiation. I will draw on examples from various branches of physics to enrich what might otherwise be a rather dry exposition of mathematical techniques.

The last part of the course will be a short introduction to the special theory of relativity, based on my own and Professor Blocker’s lecture notes. I will illustrate relativity in action with examples such as the Compton effect in particle physics and apparent faster-than-light motion in astrophysics.

There will also be occasional guest speakers on special topics -- e.g. chemical oscillators, LIGO and gravitational waves.

Outcomes: students will understand the physical properties of oscillations, vibrations and waves, and their mathematical description. Students will be able to apply this knowledge to analyze periodic phenomena in new and unfamiliar contexts, to set up the equations describing the phenomena and to solve them. Students will acquire the mathematical and physical tools that will enable them to succeed in the upper level physics courses that follow.

Text: There are two textbooks, and both of them are required. (1) “Vibrations and Waves” by George C. King (Wiley). This is a concise and very readable book. It is at just the right level. We will work through nearly all of it, and use its problems. It appears to cost $67 at the bookstore, but only $49 from Amazon. There are also cheaper used copies available, and with a little searching you can find a free downloadable PDF copy online!
(2) “Mathematical Methods in the Physical Sciences” by Mary L. Boas, 3rd edition (also published by Wiley). This is a tremendously useful book that you will be referring to throughout your career as a scientist. (I still have a corresponding book that I first used as an undergraduate at Cambridge.) Unfortunately, it is expensive - $120 on Amazon. Used copies or earlier editions are quite a bit cheaper.

**Format:** With a relatively small class, we have the luxury of conducting it partly as a seminar. This requires that everyone participates. *I expect you to attend every class and to have read the assigned reading beforehand. You must inform me and obtain my permission if for some reason you are unable to come to class.*

**Work:** There will be weekly, relatively short problem sets, a midterm and a final exam. There will also be some in-class and small group activities. Your performance in these will contribute to your overall performance grade (see below).

**Evaluation:** Your grade will be earned from the following components.
Weekly homework ..................30%
Midterm exam........................20%
Final exam.............................40%
Overall participation...............10%

These percentages are approximate (+/- 5%).

**Homework must be typed,** and it is HIGHLY RECOMMENDED that you use LaTeX. (If you do not know LaTeX, it is time to learn it, and I can give you excellent introductory materials.) Other text editors are acceptable, providing that they can handle mathematical formulas and equations.

*Success in this 4 credit hour course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, homework, discussion sections, preparation for exams, etc).*

**Disabilities:** If any student has a documented disability that requires accommodation, please see me immediately.

**Collaboration and independent work:** If you wish to collaborate on the homework problems, that’s OK. But what you hand in MUST be your own work, in your own words, and reflect your own understanding of each problem. Exams are, of course, entirely your own work. You should read and understand the university policy on academic honesty found in chapter 4 of the Brandeis University Rights and Responsibilities Handbook (http://www.brandeis.edu/studentlife/srcs/rightsresponsibilities/index.html).
PART 1: Oscillations: mostly from the King text, with additions from Boas

Chapter 1: Simple Harmonic Motion
Chapter 2: The Damped Harmonic Oscillator
Chapter 3: Forced Oscillators
Chapter 4: Coupled Oscillators

PART 2: Waves: mostly from the King text, with additions from Boas

Chapter 5: Travelling Waves
Chapter 6: Standing Waves
Chapter 7: Interference and Diffraction of Waves
Chapter 8: The Dispersion of Waves

Special class: Wave polarization and associated phenomena.

PART 3: Special Relativity: mostly from handouts

9.1 Deriving the Lorentz transformations
9.2 Time dilation and length contraction. The decay of cosmic ray muons.
9.3 Four vectors
9.4 Energy-momentum 4-vector; Wave 4-vector
9.5 Doppler shift
9.6 Aberration
9.7 Astrophysical jets and superluminal motion
9.8 Compton scattering

In class examples will include SR questions from past GRE exams.