

**WAVE MECHANICS AND QUANTUM PHYSICS**  
**PHYSICS 222**  
**Spring 2016**

*Instructor:* Sally Koutsoliotas, Olin 167, 7-3105, [s.koutsoliotas@bucknell.edu](mailto:s.koutsoliotas@bucknell.edu)

*Hours:* Lectures: Monday, Wednesday, Friday 11:00–12:00, Olin 275  
Thursday 9:30–10:30, Bert 012

*Website:* <http://eg.bucknell.edu/~koutsolts/Ph222/>

*Description:* This course will provide an overview of the important ideas and experiments that lay the foundation for modern physics. Our emphasis will be on the physics of the microscopic, described by quantum mechanics. Topics such as the structure of the hydrogen atom, the uncertainty principle, and the wave-particle duality of nature will be discussed.

To truly appreciate the developments of early twentieth century physics, a strong grounding in both the particle model and the wave model is essential. While the classical particle model is presented in PHYS 211 and more fully explored in PHYS 221, the mechanics of waves is developed in the first section of this course. Specifically, the first few weeks will focus on a detailed and thorough introduction to wave mechanics, including the development of the classical wave equation.

This class has four hour-long meetings each week. While the majority will be lectures, there will also be opportunities for problem sessions, experimental projects, and small group activities. These activities will complement the material introduced in lectures, and provide another opportunity to reinforce concepts. The mathematical tools needed to study this subject will also be developed and accompanied by a practical guide to using *Mathematica*.

Where possible, the reading associated with each lecture has been indicated in the course schedule. **It is expected that you will do the reading BEFORE coming to class.** Class lectures will focus on presenting the context for the material detailed in the text, and not on specifics relating to derivations. You are expected to work through the derivations during your reading, and come to office hours when further clarification is needed.

*Bucknell University Honor Code:*

As a student and citizen of the Bucknell University community:

- I will not lie, cheat, or steal in my academic endeavors.
- I will forthrightly oppose each and every instance of academic dishonesty.
- I will let my conscience guide my decision to communicate directly with any person or persons I believe to have been dishonest in academic work.
- I will let my conscience guide my decision on reporting breaches of academic integrity to the appropriate faculty or deans.

*Departmental Learning Goals:*

The following learning goals will be emphasized in this course:

- Develop an understanding of the fundamental principles related to waves and quantum mechanical phenomena.
- Use critical thinking skills to formulate and solve quantitative problems.
- Present well-organized, logical and scientifically sound oral and written scientific reports.
- Develop proficiency in computer programming (Python and Mathematica) and use it to solve numerical problems.

*Required Textbooks:* *Vibrations and Waves*, by A.P. French.

*Modern Physics*, 6<sup>th</sup> edition by P.A. Tipler and R.A. Llewellyn.

*Alternate References (On Reserve):*

*Waves (Berkeley Physics Course, vol.3)*, by F.S. Crawford, Jr.

*The Physics of Vibrations and Waves*, by H.J. Pain.

*Modern Physics*, by K.S. Krane.

*Concepts of Modern Physics*, by A. Beiser.

*Modern Physics*, by H.C. Ohanian.

*Quantum Physics (Berkeley Physics Course, vol.4)*, by E.H. Wichmann.

*Newtonian Mechanics*, by A.P. French.

*Useful Introductory Texts:*

*Physics (4<sup>th</sup> edition)*, by Resnick, Halliday and Walker.

*Physics for Scientists and Engineers (5<sup>th</sup> edition)*, by Tipler and Mosca.

*Related Books of Interest:*

*Feynman Lectures on Physics*, by Feynman, Leighton, and Sands.

*Thirty Years That Shook Physics*, by G. Gamow.

*Mr Tompkins in Wonderland*, by G. Gamow.

*Alice in Quantumland*, by R. Gilmore.

*The Flying Circus of Physics (with Answers)*, by J. Walker.

*Div, Grad, Curl, And All That*, by H.M. Schey.

*Office Hours:*

Monday, Wednesday 8:30–9:30 a.m.

Thursday 10:30–11:30 a.m.,

or by arrangement.

*Problem Sets:*

Problem sets will be assigned twice a week, collected, and graded. Late assignments will NOT be accepted. Solutions will be made available through the PHYS 222 website. Collaboration in the analysis of problems is encouraged, but the final write-up must be your own work entirely. Collaborators' names should be noted at the top of the first page. Discussing questions arising from the problem sets during office hours is also encouraged, especially before the work is submitted.

*Computational Assignments:*

The fourth meeting hour (Thursday) will primarily focus on computational projects related to current topics. Assignments will extend the in-class exercises and submitted regularly.

*Reading Assignments:*

Quick-response questions relating to the assigned reading will be asked regularly throughout the course. This will be done through our website. Class attendance and participation will also contribute to your grade for “Reading Assignments.”

*Tests:*

Three in-class tests, along with a take-home component, will take place during the course. These will be held during the Thursday class on:

Thursday, February 25

Thursday, March 24

Thursday, April 21

*Assessment:*

The overall grade will be made up of the following components:

Problem Sets	20%
Test 1	12.5%
Test 2	12.5%
Test 3	12.5%
Computing Assignments	12.5%
Reading Assignments, etc.	10%
Final Examination	20%
TOTAL	100%

The percentage on your final exam will replace the lowest test score, if that will help your grade.