# Tentative Syllabus for Physics 335: Fall 2012

**Professor: Dr. Stuart Hutton**
**Office: Derby Center: 248 Research Lab: Derby 219: General Physics lab: 148**
**Phone: 870 307 7560**
**Email: stuart.hutton@lyon.edu**
**To access the Physics Gateway: http://hutton.lyon.edu**

## Office Hours

I will schedule several office hour blocks. I will be very close to my office or research lab during these times. Otherwise, I will usually be close to my office or research lab. If you want to find me outside of office hours, make an appointment so that you will be sure to find me. My schedule is located on the physics home page which you may review to determine office hours.

## Grading

**As a general guide to grades, grades will be assigned as follows:**

| 100-90] | (90-80] | (80-70] | (70-60] | <(60 |
|---|---|---|---|---|
| A | B | C | D | F |

In this course, you will have several grading opportunities, tests, homework, in-class problems and laboratory projects. The various weight of each of these activities in your final point grade is shown below. **Late assignments will normally not be accepted. Additionally, since we will be doing in-class problems, poor attendance will negatively affect your grade: in particular, you will not receive credit for class participation for unexcused absences. There are no make-ups for in-class worksheets. About labs: A brief lab report will be normally due within 1 week of the lab completion. Labs will be done in accord with topics which we are covering as shown on the syllabus. We will be doing approximately 5 labs during this course.**

**Tests (3 tests)=75%**
**Each test is worth 25% of your grade.**
**Homework / in-class problems / participation=15%**
**Laboratory projects =10%**
**All lab projects must be completed or your course grade will be reduced by 10%.**

Your work on tests will be graded for correctness and clarity. **Failure to supply details leading to a result will result in very little credit for a problem**. If you want full credit for a problem, **you must** supply the logical steps that led to the result and the result **must include proper units**. Diagrams should be included where appropriate to define quantities used in your result. Homework and worksheets will be graded for completion. Students are generally expected to commit two hours of study outside of class for each hour of lecture.

## Course Description

In this course you will be exposed to the fundamentals of modern physics with topics including relativity and quantum mechanics.

## Course Objectives

As a consequence of this course, you should obtain an enhanced understanding of the fundamentals of physics. In addition, you should come away from this course with an ability to solve fundamental problems involving physical principles. The particular topics covered in this course are outlined in the schedule. Depending upon class interest, the actual topics may vary slightly from those stated. For a non-exhaustive list of assessable learning outcomes, refer to the class website.

## Course Prerequisites

You are **expected** to be proficient with algebra and trigonometry . In addition students should have course work in calculus and should have completed [Phy210/240:241] and [Phy220/250:251].

## Text

**Physics 335**:
Modern Physics for Scientists and Engineers
Third Edition
By: Stephen T. Thornton and Andrew Rex

**You may use earlier editions of this text (which can be obtained at much lower prices online {$0.25 for example is a low price}) but you will need to be sure to read the correct portions of the text.**

The schedule is designed around this particular text edition. You may use earlier or later editions but you will need to be sure to read the correct portions of the text. The text must be considered to be a very important resource so students are expected to be reading along in the text as the course progresses.

You have many resources on the campus: the library, your colleagues and your professor. Your prime learning resource, however, must be considered to be the classroom: **punctual** and **complete** class attendance is expected**. Unexcused absences will negatively impact your final grade: in particular, you will not receive credit for class participation for unexcused absences. Tardiness is considered to be an unexcused absence and will negatively impact your final grade**

## Attendance

**The Lyon College Catalogue for 2012-2013 states:**

Students are expected to attend all class periods for the courses in which they are enrolled. They are responsible for conferring with individual professors regarding any missed assignments. Faculty members are to notify the Registrar when a student misses the equivalent of one, two, three, and four weeks of class periods in a single course. Under this policy, there is no distinction between “excused” and “unexcused” absences, except that a student may make up work missed during an excused absence. A reminder of the college’s attendance policy will be issued to the student at one week, a second reminder at two weeks, a warning at three weeks, and notification of administrative withdrawal and the assigning of an “F” grade at four weeks. Students who are administratively withdrawn from more than one course will be placed on probation or suspended (see Academic Probation and Academic Suspension).

## Academic Honesty

It is expected and encouraged that students in this class will work together on homework problems. If you use reference work, be sure to include proper references. On tests, students are required to keep notes and books closed except as instructed. **Your professor will supply all the paper needed for the tests.** Any questions during tests should be directed to the professor only. **CELL PHONES AND OTHER WIRELESS OR NETWORKED DEVICES (INCLUDING COMPUTERS) MAY NOT BE USED DURING TESTS except as authorized to permitted access to reference materials**, If you do use such devices during a test to access unauthorized material, it will automatically be considered to be a violation of the Lyon College Honor Code.

**All graded work in this class is to be pledged in accordance with the Lyon College Honor Code.**

“Students seeking reasonable accommodations based on documented learning disabilities must contact the Office of Academic Services at 307-7332.”

**Tentative Schedule for Physics 335 (Modern Physics) Fall 2012**

| **Week Starting dates** | **Assignment due** | **Topics and Events** |
|---|---|---|
| August 21 | | Class Initialization |
| August 27 | | Chapter 2: Special Theory of Relativity |
| September 03 | H01 | Special Theory of Relativity |
| September 10 | H02 | Special Theory of Relativity |
| September 17 | **Test 01** | Selected Themes from Chapter 3<br>(1) e/m measurement<br>(2) determination of e<br>(3) Line spectra<br>(4) Photoelectric effect |
| September 24 | H04 | Selected Themes from Chapter 3 (continued) |
| October 08 | H05 | Selected Themes from Chapter 4<br>Classical atomic model<br>Bohr model of the Hydrogen atom<br>(failures of the Bohr model)<br>Atomic Excitation by Electrons |
| October 15 | H06 | Selected Themes from Chapter 4 (continued) |
| | | Chapter 5: Wave properties of matter |
| | | Chapter 5: Wave properties of matter |
| | | Chapter 5: Wave properties of matter |
| | | Chapter 5: Wave properties of matter |
| October 22 | H07 | Chapter 6: The Quantum Theory |
| | | Chapter 6 |
| | | Chapter 6 |
| | | Chapter 6 |
| | | Chapter 6 |
| | | Chapter 6 |
| | | Chapter 6 |
| October 29 | **Test 02** | |
| November 05 | H08 | Selected Themes from Chapter 7 |
| | | Selected Themes from Chapter 7 |
| | | Selected Themes from Chapter 9 |
| | | Selected Themes from Chapter 9 |
| November 12 | H09 | Chapter 12 |
| | | Chapter 12 |
| | | Chapter 12 |
| | | Chapter 12 |
| November 19 | H10 | Selected Themes from Chapter 13 |
| | | Selected Themes from Chapter 13 |
| | | Selected Themes from Chapter 13 |
| | | Selected Themes from Chapter 13 |
| November 26 | **Test 03** | |
| December 03 | | last week, tie up loose ends |

**Notes on the lab write-up for physics labs (Fall 2012)**

Your first (cover) page should include the following information:
Your Name, Date, Partners, Title of Experiment and the abstract.

***Each lab must be the unique written effort of the student team submitting the report. You may NOT reference or use lab reports (prepared by others, outside your team) in your report preparation.***

**Lab reports must be electronically submitted to the appropriate address as a single pdf document.**

**Title**: Concise wording that describes the essence of the lab.

**Abstract** - a summary of your research including general methods and major conclusions. This is usually one paragraph long and should convince someone to read your paper.

**Methods:** - A brief discussion of experimental techniques. Diagrams are usually appropriate in this section.

**Results** -written usually in the past perfect tense or passive voice; describes your findings, data collected, and includes data tables, graphs, general trends, derived formulas, etc. All work and data tables must be shown here. In general, you need to have a copy of your original data with you but the data included in the lab report can be copied from your original data.

**Discussion and analysis** - tense can vary, describes your results in relation to other data, discusses problem associated with the lab, postulates trends in the data, predicts results given different circumstances, suggests sources of error, etc. **Be sure to include sample calculations in this section.**

**Literature Cited** - a list of books, articles, etc., that you used to assist you in presenting your data and which were referred to in the write-up. **When citing a reference from the internet, you MUST include the URL that points directly to the document so that a single click of the mouse will bring up that exact document. Every lab report will have at least 1 citation or the report will not be accepted.**

Your presentation of the lab is important. Be sure it is grammatically correct and neatly typed. Be careful of tense changes within a paragraph. Data collected during a lab must be authentic. "Fudging" is unacceptable and unnecessary.

Lab write-ups should be as **concise** as possible within these guidelines. I am not looking for exhaustive tomes of work in a lab write-up.

As an approximate guide to how points will be assigned for the written lab reports:

+0.5 points are obtained for a clear and correct abstract.
+0.5 points are obtained for clearly stated methods, using diagrams where appropriate.
+1 points is obtained for all results included (in readable form, of course).
+0.5 points are obtained for discussion and analysis.
+0.5 points are obtained for correct and relevant and authoritative literature references.

Total for the written portion of the lab is 3 points per lab.
The total for your lab work in a lab is 10 points thus 7 points will be provided by successful and careful attention to the mechanics of the lab itself.

For Physics 335, the total number of lab points obtained will be scaled to provide 10% of the course grade except in the case one or more missed labs as provided for in the syllabus.

**Fall 2012**

**PHY 335 MODERN PHYSICS / 3 credits.** Topics in Modern Physics including relativity, elementary particles, quantum mechanics, wave and particle theories, and spectra. Prerequisite: MTH 220, PHY 220 or PHY 250 or permission of professor.

### General Education Objectives (proposed)

**1. Students can apply critical thinking to pose and answer questions.**
**2. Students can use the processes and methods of science and mathematics to demonstrate how reproducible results give rise to the discovery of fundamental laws and the development of theories.**
**3. Students can articulate a basic knowledge of current scientific understanding of the universe and the scientific and mathematical laws that govern it.**
**4l Students can summarize, interpret, analyze, and critically evaluate data and reports relating to the natural sciences and mathematics.**

The course has evolved to include approximately six short laboratory experiences during its progress. The particular experiments most recently performed are:
(1) Charge to mass ratio of the electron
(2) Photoelectric effect
(3) Gas discharge spectra
(4) Frank-Hertz experiment
(5) Identification of radiation by stopping of radiation.
(6) Electron diffraction.
Additionally, experiments for measurement of the speed of light and the temperature dependence of conductivity in semiconductors are also two labs in preparation for future courses although the present experiments are close to the maximum number permitted for a 3 hour lecture course. The exact number of experiments performed will thus vary from course to course.

## Physics Program Objectives

There are several general goals of the Physics program that students completing the physics program should have. A non-exhaustive list of these program objectives include:

(a) Ability to perform a mathematical formulation of a physical system
(b) Ability to discuss (mathematically and linguistically) a physical system drawing upon a well-developed foundation built upon physical fundamentals.
(c) Ability to formulate complex arguments based upon physical foundations and which are testable by experimentation.
(d) Ability to produce technologically enabled students with an understanding of the basis for experimental design.

### A non-exhaustive list of intended learning outcomes follows

In addition to the modern physics labs mentioned above, students completing the modern physics course should meet the following educational goals:
(a) An ability to work with simple relativity in specific circumstances.
(b) An ability to work with Lorentz Transformations to distinguish between time-like events and space-like events.

(c) An understanding of relativistic energy.
(d) An understanding of the mass spectrometer[16].
(e) The importance of the photo electric effect with regard to changing paradigms of wave-particle duality.
(f) An understanding of the Bohr model of the atom and the importance of Rutherford scattering.
(g) An understanding of essential characteristics of discharge spectra observed and how numerical characterization relates to the Bohr model.
(h) An understanding of the importance of the work of Frank-Hertz with regard to direct excitation of atomic energy levels (and their observation) by means of kinetics.
(i) Development of quantum mechanics based upon the work of De Broglie.
(j) Development of quantum mechanics based upon the work of Schrödinger.
(k) Separation of the time-dependent Schrödinger wave equation into stationary state solutions and time dependent solutions (based upon energy eigenvalues).
(l) Stationary state solutions to the Schrödinger wave equation for 1-dimensional systems with infinite boundary conditions.
(m) A detailed and highly mathematical analysis of the stationary state solutions to the Schrödinger wave equation for the 1-dimensional quantum harmonic oscillator.
(n) Introductory application of the Schrödinger wave equation to problems involving at least one finite boundary in 1-dimension.
(o) Application and understanding of the meaning, necessity and origin of the Heisenberg Uncertainty Principle.
(p) A semi-rigorous solution of the Schrödinger wave equation as applied to the hydrogen atom with particular emphasis upon the results with regard to principle quantum numbers and angular momentum.
(q) An empirical[17] introduction of spin to the quantum problem of the hydrogen atom.
(r) Introduction of the concept of selection rules based upon wave function overlap integrals as leading to the explanation for spectral intensity variations.
(s) Symmetry requirements for multi-electron atoms. Introduction of the Slater determinate and its use to determine totally symmetric and totally anti-symmetric wave functions[18].
(t) Explanation and derivation of the origins of the exchange interaction[19].
(u) Introduction to quantum statistical mechanics, the Fermi Energy, and elementary considerations leading to the Band theory for electronic conduction.
(v) Nuclear Radiation: modes of radiation, coupling of angular momentum, radioactive decay and applications of radioactive decay for dating.
(w) Explorations of the stability, size and other properties of nuclei based upon quantum mechanical results. Introduction of and examination of strong and weak nuclear forces.
(x) Extension of special relativity to general relativity[20].
(y) Introduction of relativistic concerns to quantum mechanical solutions[21].