

# Early Quantum Theory and Its Applications

PHY 305.001 --- Fall 2016 Syllabus  
Physics Department --- Mercer University

**Main Text:** Modern Physics, 3<sup>rd</sup> edition, by Kenneth Krane

**Secondary Text:** Alice in Quantumland, by Robert Gilmore; and

The New World of Mr. Tompkins, by George Gamow and Russell Stannard

**Class Meetings:** MWF 2-2:50pm, SEB 140

**Instructor:** Dr. Jose L. Balduz Jr

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**office:** SEB 205, **office hours:** MF 3-5pm, or by appointment (try email)...

Course web page: <http://physics.mercer.edu/balduz/ModPhys/defaultF16.htm>

Please also see Physics Department home page at <http://physics.mercer.edu>.

This course introduces the student to the main developments of **quantum theory** in the early part of the 20<sup>th</sup> century, including its application to **light, particles, atoms, molecules** and **statistical ensembles**. It is intended primarily for physics majors, but should be of interest also to many other students, especially those majoring in math, computer science, chemistry, and engineering. Other developments in 20<sup>th</sup> century physics are covered in the companion course **PHY 306 (Modern Physics II) Relativity, Particle Physics and Cosmology**.

Physics prerequisite is the two-semester calculus-based introductory physics sequence **PHY 161/162 General Physics I/II**. Mathematics prerequisite is a year of calculus equivalent to **MAT 191/192 Calculus I/II**.

The primary goal of this course is for students to develop conceptual understanding of these topics rather than detailed knowledge, which they can gain in more advanced courses. The secondary goal is for students to learn the rudiments of the mathematics of quantum physics. By mastering the material in the main text, students will be able to describe the basic experimental results that led to the quantum revolution; to perform calculations concerning the wave-particle behavior of matter and radiation; to understand and explain basic concepts like Heisenberg's uncertainty principle and quantum probability; to apply the Schroedinger equation to simple systems like the hydrogen atom and potential wells; to manipulate atomic wavefunctions in order to describe the electronic orbitals of many-electron atoms and molecules; and to perform simple statistical physics calculations. Writing essays based on the supplementary texts will bring students conceptual understanding, and the ability to explain and discuss the more challenging and picturesque aspects of quantum theory.

**Lectures:** During most class meetings there will be some conventional lectures. We will also discuss the material and go over questions and problems in the text, as well as homework and test problems.

**Office hours:** Please come see me! If you're doing well in the course, we can talk about physics concepts and the big picture; or about your life after Mercer; or other things... If you're not doing so well in this class, I can try to help you one-on-one, before you get too far behind. Typically that means talking about the material with you, but also having you work problems with me right in my office. There's no substitute for working through a problem yourself, with someone by your side that knows the way...

**Homework:** For each covered chapter of the main text the instructor will assign a set of homework problems to be worked by the students and handed in for grading. Students are encouraged to collaborate on these; however, each must hand in their own separate paper. After the papers are collected, a solution sheet will be provided. Altogether, the homework will count for 40% of the total grade.

**Take-home Tests:** There will be three of these, containing primarily numerical problems and derivations, but also some conceptual questions. The only resources allowed each student for these are the text, class notes and the instructor. Altogether, the take-home tests will count for 30% of the total grade.

**Essays:** Certain days (6 in all) will be primarily devoted to discussion of the material from the secondary texts. On the morning of the essay day, the students will "hand in" a short essay (electronic submission by email) on the reading material. These will be presented to the class by them, and in part will form the basis for discussion. The first three essays will be at least 500 words each, while the last three will be at least 750 words each. All the essays together will count for 15% of the total grade.

**Final Exam:** This will take place on **Monday 12/12** at 2-5pm. It will be mostly qualitative and open-book, will cover all the material from the main text, and will count for 15% of the total grade.

**Grading:** The percentage for each activity is shown in the left table below. To convert the total percent to a letter grade, use the scale shown in the right table below.

	#	total %
<b>Homework sets</b>	10	40
<b>Tests</b>	3	30
<b>Essays</b>	6	15
<b>Final Exam</b>	1	15
		<b>Total: 100</b>

	GP	%
<b>A</b>	4.0	90-100
<b>B+</b>	3.5	85-89
<b>B</b>	3.0	80-84
<b>C+</b>	2.5	75-79
<b>C</b>	2.0	70-74
<b>D</b>	1.0	60-69
<b>F</b>	0.0	0-59

## **Miscellaneous policies:**

If changes to this syllabus are necessary, they will be implemented after discussion and negotiation with the students. Note that the accompanying course schedule is not a part of the syllabus: it is tentative and subject to revision, including all due dates.

**Assignment due dates:** Homework assignments and take-home exams are always due in class on the due date: However, they will not be considered late as long as they are turned in before the next sunrise (or first thing in the morning). Essays are always actually due on the morning of essay reading day (first thing). Beyond that, any late assignments will suffer a 5% penalty per day (excluding weekends and holidays) until they are handed in: i.e., 5% on the first day, 10% on the second day...; up to a maximum penalty of 50% after 10 days.

There will be no dropped grades or extra-credit work. All work done in the course will be counted.

**Honor Code:** The College of Liberal Arts' academic misconduct policy will be followed. All students are bound by the Mercer University Honor Code...

**Disability support:** Students requiring accommodations for a disability should inform the instructor at the close of the first class meeting or as soon as possible. The instructor will refer you to the Disability Support Services Coordinator to document your disability, determine eligibility for accommodations under the ADA/Section 504 and to request a Faculty Accommodation Form. Disability accommodations or status will not be indicated on academic transcripts. In order to receive accommodations in a class, students with sensory, learning, psychological, physical or medical disabilities must provide their instructor with a Faculty Accommodation Form to sign. Students must return the signed form to the Disability Services Coordinator. A new form must be requested each semester. Students with a history of a disability, perceived as having a disability, or with a current disability, who do not wish to use academic accommodations are also strongly encouraged to register with the Disability Services Coordinator and request a Faculty Accommodation Form each semester.

For further information, please contact Carole Burrowbridge, Disability Services Coordinator, at 301-2778 or visit the Disability Support Services website at <http://www.mercer.edu/studentaffairs/disabilityservices>

All requests for reasonable accommodation are welcome also in regard to absence from class for school representation (i.e., athletic or other events) or personal/family problems.