SYLLABUS - PHYS 461 [561] Modern Physics (3 unit) at Northern Illinois University, Department of Physics

Professor C. Thompson[1, a)]
Northern Illinois University

(Dated: 14 January 2014: version 2c for Spring 2014 semester)

Class meets - Tuesday and Thursday 3:30 - 4:45 pm in Faraday Hall 237
Faculty - Professor C. Thompson (815-753-1772)- cthompson@niu.edu - LaTourette Hall 207
`http://www.physics.niu.edu\~cthompson`
Office hours - Thur 10:00-noon but preferred arrangemnt is by appointment to get my uninterrupted attention. Please just go ahead and contact me!

Textbook -
Required - Quantum Mechanics - Foundations and Applications, D. G. Swanson (2007), Taylor and Francis (CRC Press).
Other useful references for the course - see section III.

The timeline for chapters and sections covered is listed in body of syllabus.

Midterm is March 7, 2014. Final exam is Tues. May 6, 2014, 4-5:50 p.m, Final is cumulative.

This syllabus is a guide and every attempt is made to provide an accurate overview of the course. However, circumstances and events may make it necessary for the instructor to modify the syllabus during the semester and may depend, in part, on the progress, needs, and experiences of the students. Changes to the syllabus will be made with advance notice.

I. CLASS INFORMATION AND CONTEXT

Catalog descriptions:
PHYS 460 [**560**]**. Quantum Physics (3 credit)***: Schrodinger wave equation, eigenvalues and eigenfunctions, methods of approximation and applications to the square well, the harmonic oscillator, and hydrogen-like atoms. PRQ 460: PHYS 300 and PHYS 370 and PHYS 383. [PRQ 560: PHYS 300 and PHYS 370, or consent of department.]*

PHYS 461[**561**] **Modern Physics (3 credit)**. *Applications of quantum physics to atoms, molecules, solids, nuclei, and elementary particles. PRQ 461: PHYS 460 or consent of department. [PRQ 561: PHYS 560 or consent of department.]*

The two semester course (Phys 460/461) is the senior-level undergraduate course of quantum for physics majors. The first semester is required for the professional physics emphasis, **strongly recommended** for the other emphases (applied physics and physics education). Classes meet simultaneously with Phys 560/561 (grad credit).

Graduate level course (Phys 560/561) is a suitable introductory quantum physics sequence for graduate students from departments who did not complete a quantum course at this level of mathematical rigor in their undergraduate programs (chemistry, engineering, mathematics). It also is suitable for graduate students who are advised to take a refresher or background course before tackling the Phys 660/661 quantum sequence required for the MS and PhD physics sequences.

Lectures for Phys 460/461 are the same as for Phys 560/561. The course for graduate credit has expectations that the student develops a deeper level of sophistication in mastery of the topics. To achieve this and to assess this, for graduate credit, additional selected problems on the homework are required. They will typically be chosen because of they illustrate or provide advanced insight into the topics and concepts. The tests and quizzes will incorporate subsets that include more advanced problems.

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II. GRADING AND GRADING POLICIES

While every effort will be made to keep the website up to date - students are responsible for any issues that occur if they miss in-class announcements that affect grading, exam topics, homework deadlines, problem hints, problem changes and similar items.

A. Homework deadlines and extra credit

Homework may be turned in electronically or in class. Homework more than 1 week late will not be counted for credit unless arrangements were made in advance with the instructor.

B. Journal Club

For each homework set - student must identify an article in the archival literature that uses concepts or topics of lectures and described how they relate to the article. Student must hand in the following with their homework set 1) a copy of the article, 2) a short description in their own words for what/how topics are relevant (which also shows that the students has read the article). Students are not expected to understand everything in the article!

For Journal Club week - each student will choose one of the articles that they have researched above, and give informal presentation on it and all students will discuss and ask questions.

C. exams

Take home Midterm is during 8th week. Final exam is Tues. May 6, 2014, 4-5:50 p.m., Final is cumulative.

D. Scoring of exams and homework - based on percentage of total points total

Homework:	85% A(4) 75% B(3) 65% C(3) 55% D(1)
Quizzes and in class exercises:	85% A(4) 75% B(3) 65% C(3) 55% D(1)
MIDTERM Exam:	80% A(4) 70% B(3) 60% C(3) 50%D(1)
FINAL Exam:	80% A(4) 70% B(3) 60% C(3) 50%D(1)

E. Final grade determinations

The final grade s determined using the following weights Homework - 30%; Quizzes and in class exercise - 10% Midterm - 25%; Weekly Journal Club and Final Journal Club presentation - 10%; Final Exam - 25%;

Graduate students and undergraduates may receive ± grades. Final Letter grade for course is calculated similar to a 'gpa' from the letter grades using the weightings listed above. Score calculated above is assigned to final letter grade for course as follows - 3.69 (A), 3.35 (A-), 3.02 (B+), 2.69 (B), 2.35 (B-), 1.95 (C), 0.95 (D), <0.95 (F).

The FINAL exam may be waived if HOMEWORK cumulative points are greater than 90% total, and student achieved an A on the midterm and if lecture attendance was greater than 90%. (Weighting will then be Homework 40%, Midterm 35%, and Quizzes and in class exercies 10%, Journal Club 15%.)

III. SUGGESTIONS FOR USEFUL REFERENCES

Books that are useful for this class can be found on ebay and amazon and in used bookstores. Books titled Modern Physics tend to be for the slightly lower level class (e.g., Phys 293 or 383) that is based on the last semester of the 2 year intro sequence. If the title combines Modern Physics and Quantum Mechanics - it is likely for a course at this level. A text that says Quantum Mechanics or Quantum Physics may be for this level. It is usually pretty clear from reading the preface whether the book is designed for an introductory (Freshman/Sophmore) semester sequence, for the advanced undergraduate/refresher grad or for a MS/PhD graduate program course. Within a particular level,

Week of course	*Chapter headings*	*notation if topic is in Swanson*
one	Review, then Approximation Methods (Non degenerate perturb theory 1st and 2nd order)	Ch 5.1-2
two	Approximation Methods (Degenerate states, time dependent theory)	Ch 5.3-5
three	Approximation Methods (Variational and WKB methods)	Ch 5.5-5.6
four	Atomic Spectroscopy	Ch 6
five	Quantum Statistics (Derive the distribution laws and discuss general applications)	Ch 7.1-2
six	Quantum Statistics	Ch 7
seven	Band Theory of solids	Ch 8 and others
eight	review and midterm	Thurs Midterm
nine	SPRING BREAK	
ten	Band Theory of Solids	Swanson Ch 8
eleven	Band Theory of Solids - and Additional topics, *e.g.*, Superconductivity, Magnetism, transport	other sources needed
twelve	Additional topics, Nuclear Physics	other sources
thirteen	Additional topics, Particle Physics	other sources
fourteen	Emission, Absorption, and Lasers	Ch 9
fifteen	Journal Club week	
sixteen	Relativistic QM and more Particle Theory	Ch 11
seventeen	FINAL EXAM (see catalog)	cumulative

the fundamental topics covered will be similar - but how the topics are put together to form a solid backbone is different depending on the pedagogical vision of the author.

The second half of the class (PHYS 461/561) (e.g., applications of QM) sees important differences in topics included in books published 20-30 years ago and now. Which 'applications' go in and out of fashion and depend on the envisioned target audience. Also, as research has advanced in the various areas, authors will attempt to evolve the pedagogy to be more supportive of understanding the new topics, or they may simply attempt to bring in a bit of enrichment.

A random selection of books that have material at the right level, (arranged by date of publication) - these happen to be ones I have.

- *Quantum Mechanics - Foundations and Applications*, D. G. Swanson (2007), Taylor and Francis (CRC Press).
- *Introduction to Quantum Mechanics in Chemistry, Materials Science, and Biology*, S. M. Blinder (2011), Elsevier Press Complementary Science Series.
- *Quantum Physics*, S. Gasiorowicz (2003), 3rd edition, Wiley.
- *Introductory Quantum Mechanics*, R. L. Liboff (2003), 4th edition, Addison Wesley Press.
- *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles*, R. Eisberg and R. Resnick, 2nd edition, Wiley.
- *Modern Physics and Quantum Mechanics* E. E. Anderson (1971), 1st edition, W. B. Saunders Co.
- *Basic Quantum Mechanics*, R. L. White (1966), 1st edition, McGraw Hill Book Co.
- *Principles of Modern Physics*, R. B. Leighton (1959), 1st edition, McGraw Hill Book Co.

Of interest - some textbooks that could be used to enrich special topics appropriate for this course.

- *Subatomic Physics*, E. M. Henley and A. Garcia (2007) 3rd edition, World Scientific Publishing Company.
- *Nuclear and Particle Physics: An introduction*, M. R. Martin, (2006), John Wiley and Sons, Ltd.

IV. STANDARD POLICIES AND PROCEDURES

1. Cheating will not be tolerated, and will be dealt with according to the NIU Student Code of Conduct.

2. It is true - Reading the book and allowing more time to work on homework problems without cramming it all in a few hours, help students understand the material. Please read the chapters in advance and keep working at the homework steadily.

3. Homework studying may be done in groups and students are encouraged to seek help.

4. Homework - students should be comfortable acknowledging and citing sources that are used whether in writing a paper, developing research ideas, or getting significant help on answering or understanding answers on working problems. Be transparent and honest. Acknowledge (in writing) sources or students who helped significantly, in particular, if the homework would not have been done on time and correctly without that help.

5. EXAMS: If emergency medical crisis or family crisis interferes with attending an in-class EXAM, contact Professor Thompson by phone, mail, or email, as soon as practical. Give enough specific information to let Professor Thompson assess the situation and start plans for accommodation. Any realistic timeline is also helpful (i.e., is this a life-altering event requiring several weeks to overcome, or was this just a very scary event but will have a quick recovery?) (Cramming the night before and oversleeping is not considered an emergency, nor is running out of gas).

6. For the non-emergency 'stupid' things (which do happen, regrettably) do not panic. If the exam has already started, please contact the Physics office as soon as possible at 815-753-1772. Leave contact information, short assessment of situation and the expected timeline for getting to the department as soon as possible. Reality check - students who rarely show up in class or complete the homework do not get much good-faith accommodation for non-emergency situations.

7. NIU abides by Section 504 of the Rehabilitation Act of 1973 which mandates reasonable accommodations be provided for qualified students with disabilities. The NIU Disability Resource Center, located on the 4th floor of the University Health Service (815.753.1303) is the designated office on campus to provide services and accommodations to students with diagnosed disabilities. You need to provide documentation of your disability to DRC if you seek accommodations in this course. Your success as a student is of utmost importance. If you have a disability or any other special circumstance that may have some impact on your work in this class, and for which you may require special accommodations, please contact me early in the semester so that accommodations can be made in a timely manner.

8. Requests for accommodation for missing classes due to work schedule changes, department, student club, or class activities - please handle these outside of class (in my office or by email or phone). Please bring in written summary (or email it to me in advance) relevant information, dates, times, requests and why. This is so the instructor REMEMBERS later!

9. Incompletes and procrastination: Grades of Incompletes (I) are given when serious circumstances arise causing chronic disruptions of the student's ability to concentrate at his or her usual level of performance. This can happen to anyone. So please, be proactive, be professional and be realistic.

   Examples might be severe illness lasting several weeks or more, or the normal coping response to physical or emotional traumas such as an assault, the death or illness of a close family member, divorce, breakup. These can really throw off any student! Please be proactive and do not 'tough it out' when special situations arise. Students should start talking to the instructor or the college advisors when things start breaking down.

   Note that an I (incomplete) is not given for 'chronic' procrastination due to poor schedule planning, inability to develop good study habits, ignorance, or immaturity.

10. For medical withdrawals, (requests to college to be dropped from a class (after the deadline for withdraw has passed) - the Withdraw Pass (WP) or Withdraw Fail (WF) grade will usually be determined by the pro-rated grade that student was achieving by the Friday after the midterm (which otherwise is the last day to withdraw from classes and receive a (W).)

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