

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

Professor C. Thompson^{1, a)}

Northern Illinois University

(Dated: printed 13 January 2015: version 1a for Spring 2015 semester)

Class meets - Tuesday and Thursday 9:30 - 10:45am in LaTourette Hall 227

Faculty - Professor C. Thompson (815-753-1772)- cthompson@niu.edu - LaTourette Hall 207

<http://www.physics.niu.edu/~cthompson>

Office hours - Thur 11:00-noon but preferred arrangement is by appointment to get my uninterrupted attention. Please just go ahead and contact me!

Textbook -

Useful references for the course - see section II B.

Take home Midterm will be scheduled in March. Final in-class exam is Thurs. May 7, 10-11:50 a.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 in their undergraduate programs (e.g., chemistry, engineering, mathematics). It also is suitable for graduate students who are advised or wish to take a refresher 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 and demonstrates a deeper and more sophisticated mastery of the topics. To achieve this and to assess this, additional selected problems on the homework are required for graduate credit. They will typically be chosen because they illustrate or require advanced insight into the topics and concepts, and more facile ability with seeing the connections between the topics. The tests and quizzes for Phys 560/561 will incorporate subsets that include more advanced problems.

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II. TOPICS AND RESOURCES

A. Phy 461/561 typical topics

Typical topics are selected from among the following.

- Atomic Spectroscopy
- Emission, Absorption, and Lasers
- Quantum Statistics
- Quantum physics applied in biology, chemistry, or applied physics
- Band theory of matter
- Cooperative phenomena - Superconductivity, Magnetism
- Transport
- Nuclear Physics and Nuclear Processes
- Particle Physics and High Energy Physics

And because Time dependent perturbation theory was skipped for Fall 2014, we will need to cover it to support some of our applications.

B. Suggestions for useful references

Books that are useful for Phys 460/560 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/Sophomore) semester sequence, for the advanced undergraduate/refresher grad or for a MS/PhD graduate program course. Within a particular level, 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 level of treatment of some topics included in books published 20-30 years ago and now. Which 'applications' go in and out of fashion. 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. Also the latter half of Eisberg and Resnick listed above and the Leighton. The Blinder book above also has many interesting application examples focused on chemistry, engineering, and physics.

- *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.

III. 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 and at other times announced in class, - student will identify an article in the archival literature that uses concepts or topics of lectures and describe how these concepts relate to the article. Student must read the article, and hand in the following for the Journal Club credit 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!

Students may work together in teams to identify, to read, and to study an article, however, the short description should be individually written.

Students also will present on their articles, giving an informal presentations.

C. Exams

Take home Midterm is during 7th week. Final in-class exam is Thurs. May 7, 2015 - 10-11:50 a.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)
ATTENDANCE:	More that three (3) unexcused absences is an automatic F.

E. Final grade determinations

The final grade s determined using the following weights Homework - 30%; Quizzes and in class exercise - 10% Midterm - 25%; Journal Club assignments - 10%; Final Exam - 25%; and the attendance gotcha if necessary.

Graduate students and undergraduates may receive \pm 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 - 3.81 (A), 3.48 (A-), 3.15 (B+), 2.81 (B), 2.48 (B-), 2.15 (C+), 1.81 (C), 0.81 (D), <0.81 (F).

The FINAL exam may be waived if HOMEWORK, Quizzes and in-class exercises, and Journal Club cumulative points are each individually greater than 90% of their respective totals and if lecture attendance was greater than 90%. (Weighting of final grade in this case will then be Homework 40%, Midterm 30%, and Quizzes and in class exercises 15%, Journal Club 15%.)

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 assignments 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 or the physics office by phone, mail, or email, when practical. Give enough specific information eventually to Professor Thompson to let her 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 with a quick recovery?) (Cramming the night before and oversleeping is not considered an scary 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. Excused absences - Illness - Contact Professor Thompson as soon as practical. Other requests for excused absences 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.
9. Incompletes and procrastination: Grades of Incompletes (I) may be given at the discretion of the instructor when serious unforeseen circumstances arise causing a 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 two or three weeks, or the normal coping response to a 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.

Note that an I (incomplete) is not used to accommodate 'chronic' procrastination due to poor schedule planning, inability to develop good study habits, ignorance, or immaturity, or bad attitude.
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 achieved by completion of the midterm (which otherwise is graded and returned prior to the last day for a student to choose to withdraw from classes and receive a (W).)

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