Physics 652 - Quantum mechanics - Spring17

Instructor
Renate Wackerbauer,
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e-mail: rawackerbauer@alaska.edu

Open office hours
Walk-ins are very welcome; appointments help; email is effective for straightforward questions.

Course info
Phys652, 3 credits

Prerequisites
graduate standing or instructor's permission

Lectures
MWF 13:00 to 14:00 pm, REIC 207.
The lectures will explore in depth material presented in the text.

Noyes Lab
Access to the Noyes Computer Lab (Rm 101 NSCI) is provided to all students enrolled in a Physics course. Your polar express card lets you in.

Text
Required text:

Supplementary readings:
*Lectures on Quantum mechanics*, by G. Baym, Benjamin/Cumings (1973)
--graduate level book
--clearly written introduction; good basis for the author's book on advanced quantum mechanics.
--undergraduate book, excellent for filling some lack in qm
--introductory book on quantum mechanics

There are many books on quantum mechanics in the library that almost all cover the material presented in the lectures. Please explore them to see different approaches to our topics.

Course Content
This course is a continuation of Phys651 (Quantum mechanics I), an introduction into quantum mechanics at the graduate level. We will cover the spin, the addition of angular momenta, WKB approximation, Ritz's principle, time-independent and time-dependent perturbation theories and physical phenomena related to these perturbation theories, scattering theory, and Dirac's equation.

Tentative course calendar

Homework
Homework will be assigned weekly and will be due by 4:00 pm on the following Friday, unless explicitly altered at the time of assignment. Late homework will not be accepted. Finished homework should be placed in the designated box in the main office of the Physics Department. Homework assignments and solutions will be posted in the glass case in the Physics Department hallway.
I HIGHLY appreciate it if you RECYCLE paper for your homeworks!

Paper, Presentation
*Explore the fun and "strange world" of quantum mechanics! Explore a topic related to this course on your own. This can be an application of quantum mechanics in medicine, in nanotechnology, biology, etc. It can be on non-hermitian quantum mechanics, quantum chaos, alternative theories like Bohm's pilot wave theory, Feynman's path integrals, a bridge between classical and*
quantum mechanics; it can be on Bell's theorem, the EPR experiment, quantum computation, quantum cryptography; many other topics are possible, follow your own interest. This topic will be explored by you in a concept paper and an oral presentation. A good way to get started is to browse through "physics today" to find an interesting article on quantum mechanics that you will prepare such that the class can understand. The project needs to be based on a published paper or advanced text book, online sources like Wikipedia are not allowed.

**Concept Paper:** The concept paper starts with the **hypothesis** to be addressed in the paper; and continues with the explanation of a quantum mechanical **concept** the focus is on how the concept is explained and whether it can be understood by an undergraduate physics student that had an introductory QM course. The use of any formula needs to be approved by the instructor at latest 2 weeks before the paper is due. The concept paper represents the basis and key message of the oral presentation. Goal is to formulate the concept as a take home message that is so well explained that the audience will never forget about it, no "hiding" behind a sequence of formulas or derivation. The paper should consist of 2 pages (single column, 11pt, regular (single) line spacing, margins up to 1 inch in either direction) of text; 3-5 references, figures, and formulas (if approved) do not contribute to the 2 pages. The topic should be discussed with the instructor, and is due FEB 15: the paper is due MARCH 29. The project needs to be turned in as a HARD COPY and as PDF file. The grade is determined from physics (70%) and style (30%) of the paper. The physics part includes hypothesis formulation, correct physics, level covered, how explained, how introduced, understanding, terms defined. The style part includes organization and structure, references given, figures referenced, writing style.

**Presentation:** The quantum concept will be presented to the class in a 10 minutes presentation the week before finals. The presentation needs to be turned in as a PDF file, at latest the day after presentation. The grade is determined from clarity of presentation (50%) and content (50%). The clarity of presentation includes board/transparency use, clarity of writing/slides, references used, blocking board/screen, speaking clearly and loud, speed of speech, facing class and eye contact, dealing with questions. The content includes appropriate level, enough details, terms introduced before used, correct physics, how explained.

### Examinations

A one-hour in-term examinations and a two-hour final examination will be held during the semester. In-term exams will be held in the classroom. The exams will be closed books and closed notes.

<table>
<thead>
<tr>
<th>Midterm exam</th>
<th>Friday, March 10</th>
<th>Shankar, approx chapt 12-16</th>
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<tr>
<td>Final exam</td>
<td>WEDday, May 3, 1-3pm</td>
<td>Shankar, approx chapt 12-20</td>
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### Grading

The maximum score for each homework will be 100 points. A solution (homework, exam) that presents nothing more than a restatement of the problem will receive zero credit. Credit will be given for clarity of presentation, illegible work will not be graded. **Grades are assigned as follows:**

- A+ (>95%), A (>90%), A- (>85%), B+ (>80%), B (>75%), B- (>70%), C+ (>65%), C (>60%), C- (>55%), D+ (>50%), D (>45%), D- (>40%), else F.

For the final grade homeworks, exams, etc. will be weighted as follows

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
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<tr>
<td>Paper</td>
<td>10%</td>
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<tr>
<td>Midterm</td>
<td>20%</td>
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<tr>
<td>Course policies</td>
<td>Final exam</td>
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<td>Attendance at lectures is expected. Active class participation, questions, comments on newspaper articles on modern physics are extremely welcome in the lectures. A missed exam will receive 0 credit unless the instructor is notified by email, phone, etc before the exam starts. Make-up exams will be individually scheduled with the student.</td>
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<td>Student Obligations</td>
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<td>As students of UAF, you are bound by the policies and regulations of the University of Alaska, UAF rules and procedures, and the Student Honor Code. You are obligated to make yourselves familiar with all conditions presented in the UAF Catalog. <strong>Plagiarism on homework, or on exam, or on presentation or on paper will result in a failing grade.</strong></td>
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<td>Disabilities Services</td>
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<td>The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. If you have any kind of dissability, please ensure that you go to the dissabilities services program coordinator. I will work with the office of disabilities services (203 WHIT, 474-7043) to provide reasonable accomodations to students with disabilities.</td>
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