# Physics 421 - Quantum mechanics - Fall 2019

| Instructor       | Renate Wackerbauer,  
|                 | Office Location: REIC 106  
|                 | phone: 474-6108  
|                 | e-mail: rawackerbauer@alaska.edu  
| Open Office hours | Walk-ins are very welcome; appointments help; email is effective for straight-forward questions.  
| Course Info      | Phys421, 4 credits  
| Prerequisites    | Phys213, 220, 301, 341; or permission of instructor.  
| Lectures         | MWF 10:30 to 11:30 am, M 4:40-5:40, NSCI 207.  
| 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:**


--This book represents a detailed introduction into modern quantum physics, tells also about the history and experiments in QM.

*Lectures on Quantum mechanics*, by G. Baym, Benjamin/Cumings (1973)

--for further reading, usually at graduate level


--clearly written introduction; good basis for the author's book on advanced quantum mechanics.

*The infinite well and Dirac delta function potentials as pedagogical, mathematical and physical models in QM*, M. Belloni and RW. Robinett, Physics Reports, 2014

-- for further reading with interesting applications

*There are many books on introductory 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

### Tentative course calendar

Schroedinger's equation, Born interpretation, operator formalism, measurement and projection, stationary states, one-dimensional systems, hydrogen atom, states of definite angular momentum, perturbation theory

## Course Goals

This course provides an introduction into quantum mechanics, the physics of the microscopic particles like electrons, protons, atoms, etc. The Schroedinger equation - the quantum mechanical equation of motion is studied in very detail for different physical systems. Where does Heisenberg's uncertainty relation really come from, is there just one or are there many?

## Student Learning Outcomes

Students learn,

--how particle behavior in the microscopic world differs from the macroscopic world

--how to describe and solve problems in theoretical quantum mechanics

--some limitations of classical analogons in quantum mechanics

--how measurement processes are different in quantum mechanics and classical physics

## Homework

Homework (10 assignments, each counting 100pts) will be assigned weekly and will be due by **4:00 pm** on the following Wednesday, unless explicitly altered at the time
of assignment. Late homework will not be accepted. Finished homework should be placed in my mailbox in the main office of the Physics Department. Selected 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 homework! You can earn 100 bonus points in the homework by giving a 10min presentation to class on a topic related to class, for example the life of a quantum physicist, an application of quantum mechanics, experiments on quantum mechanics, etc.

in case of issues with the homework link use: ffden-2.phys.uaf.edu/wacker/CLASS/421hw.html

Examinations
Two 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. Upon request, an additional review class may be scheduled before each exam. The exams will be closed books and closed notes. No calculators, computers, or communication devices are allowed.

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<tr>
<th>Exam (in class)</th>
<th>Date</th>
<th>Textbook</th>
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<tbody>
<tr>
<td>Exam 2 (in class)</td>
<td>Wed, Nov 13</td>
<td>Griffiths: approx. chapt. 4-6</td>
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<tr>
<td>Final Exam</td>
<td>Wednesday, Dec 11, 10:15-12:15am</td>
<td>Griffiths: approx. chapt. 1-9</td>
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Grading
The maximum score for each homework will be 100 points. *Illlegible work will not be graded.* To pass the course with a grade higher than "F", you need 40% of the total credits. Grades A to D are assigned equal weight for total credits between 40% and 100%. So, A+ (>97.5), A(>87.5), A-(>85), B+(>82.5), B(>72.5), B-(>70), C+(>67.5), C(>57.5), C-(>55), D+(>52.5), D(>42.5), D-(>40). If this class is in your major you need at least a grade C- for passing the course and fulfilling prerequisites. For the final grade, homework, exams, etc. will be weighted as follows:

<table>
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<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
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<tr>
<td>Exam 1</td>
<td>25%</td>
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<tr>
<td>Exam 2</td>
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<tr>
<td>Final Exam</td>
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Course policies
Attendance at lectures is expected. Active class participation, questions 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.

Student Obligations
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. *Plagiarism on homework or on an exam will result in a failing grade.*

Student protection and services statement
Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/.

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: https://alaska.edu/nondiscrimination/.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy:
“The letter “I” (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student’s control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an “I” grade.”

Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English Department's Writing Center (907-474-5314, Gruening 8th floor), and/or CTC's Learning Center (604 Barnette Street, 907-455-2860).