Physics 486/686 Spring 2021

QUANTUM MECHANICS II

3 credits


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Meetings: Tu Th 2:00-3:15 Office Hours: W 14:00-16:00
South Engineering 221 (or by arrangement)

Goal: To master the foundations of quantum mechanics, including fundamental concepts, key experiments, theoretical methods, and practical applications to a variety of systems.

Student Responsibilities: According to current NDSU health regulations, a proper face covering must be worn for all face-to-face class activities. Read assigned material in advance. Come prepared for discussion. Ask questions and give me feedback. Complete assignments on time.

HyFlex Options: Students have an option of taking the course remotely. You can view and participate in the class meetings, use office hours remotely, access and submit the assignments and exams via your NDSU email account. See https://kb.ndsu.edu/learn web resource for students on HyFlex.

Note that you will need reliable internet access for this option.


Major Topics:
• Angular Momentum: Spin, Addition of Angular Momenta
• Identical Particles: Bosons, Fermions, Atoms, Solids, Quantum Statistical Mechanics
• Time-Independent Perturbation Theory: Nondegenerate and Degenerate Cases, The Fine Hydrogen Structure, The Zeeman and Hyperfine Splitting
• The Variational Principle: The Helium Ground State, The Hydrogen Molecular Ion
• WKB Approximation: Tunneling, Wave Function Matching
• Quantum Dynamics: Two Level Systems, Emission and Absorption of Radiation
• The Adiabatic Approximation (if time permits)
• Scattering: Partial Waves, Phase Shifts, The Born Approximation
• The Conceptual Issues: The EPR Paradox, Bell’s Theorem, The No-clone Theorem, Schrödinger’s Cat, The Quantum Zeno Paradox (if time permits)

Evaluation: homework assignments (40%); 3 exams (15%, 15%, 30%); assignments for graduate students will include an additional project.
Homework and Lateness: Group discussion of homework is strongly encouraged, but written solutions must be your own. Late work will be accepted with a 20% penalty/day until next class.

Grading: A: 90-100%, B: 75-89.9%, C: 60-74.9%, D: 50-59.9%, F: < 50%; assignments for graduate students will include an additional project.

Health and Safety Expectations, Attendance:
See [www.ndsu.edu/admission/fall_2020_prelim_plan](http://www.ndsu.edu/admission/fall_2020_prelim_plan) for information on COVID-19 and NDSU’s response.

- Students must follow NDSU guidance on face coverings, physical distancing, and sanitation.
- Do not come to class if you are sick. You can view the lectures and ask any questions you have remotely.
- I will be flexible regarding deadlines for students who are experiencing illness or other challenges related to COVID-19. Please contact me as early as possible if you think you may not be able to complete an assignment or participate in the course due to illness.
- NDSU requires students to wear face coverings in classrooms. Wearing face coverings helps reduce the risk to others in case you are infected but do not have symptoms.
- You must properly wear a face covering (covering both the mouth and nose) for the entirety of the class.
- If you fail to properly wear a face covering, you will not be admitted to the classroom. However, you may choose to participate in the class remotely. The following will be used as needed: referral to Dean of Students Office or administrative removal from class.
- Students who cannot wear a face covering due to a medical condition or disability may seek accommodation through Disability Services (701-231-8463; [https://www.ndsu.edu/disabilityservices/](https://www.ndsu.edu/disabilityservices/)).
- Disinfecting supplies are provided for you to disinfect your learning space. You may also use your own disinfecting supplies.
- Students should observe social distancing guidelines whenever possible. Students should avoid congregating around instructional space entrances before or after class. Students should exit the instructional space immediately after the end of class to ensure social distancing and allow for the persons attending the next scheduled class to enter the classroom.
- In accordance with NDSU Policy 601, failure to comply with instructions, including this syllabus, may be handled according to the Code of Student Conduct resolution process and may result in disciplinary sanctions.
Additional Statements:
1. Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.
2. Any students with disabilities or other special needs, who need special accommodations in this course are invited to share these concerns or requests with the instructor and contact the Disability Services Office as soon as possible (ndsu.edu/disabilityservices).
3. The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.