Instructor: Thomas Ihle  
Office hours: 3:15-4:15 p.m. Tuesday; 3:30-5 p.m. Thursday, South Engineering 212 A

Meetings:  Lecture: 9:30-10:45 a.m. Tuesday and Thursday, Minard Hall Rm 306

Office hours: 3:15-4:15 p.m. Tuesday; 3:30-5 p.m. Thursday, South Engineering 212 A


Prereqs: PHYS 252 (University Physics II), MATH 265 (Calculus III)

Bulletin description:
Breakdown of classical physics, special relativity, Bohr model, Schrödinger mechanics of simple systems, atomic structure, selected topics from nuclear and solid state physics.

Prereqs: PHYS 252, MATH 265

Course objectives:
Students will develop a "scientifically literate" level of understanding of relativity and quantum mechanics and their application to 21st century science and engineering. Students will enhance their ability to think critically and solve real world problems. Students will be able to apply and understand the equations of special relativity and quantum mechanics for a variety of conditions. Students will recognize that physics is an exciting and dynamic field of study.

Course description and tentative schedule:

This course is about special relativity and quantum mechanics, that is, the physics developments of the early 20th century necessary to comprehend the applications of the 21st century. We will explore the theory of special relativity, the Bohr model of the atom, Schrödinger’s mechanics of simple systems, and the quantum mechanics of atomic and molecular structure. General relativity, i.e. the theory of gravity, and nuclear physics will be briefly discussed only. This is a required course for the undergraduate Physics major. The course provides a foundation for most upper level physics courses and many graduate engineering and materials science courses. Many upper level texts and instructors will assume a familiarity with special relativity, quantum mechanics and the structure of atoms and molecules.

- Week 1: Introduction to relativity, Michelson-Morley experiment (chapt. 1),
- Week 2: Lorentz transformation, time dilation, twin paradox (chapt. 1)
- Week 3: Length contraction, pole-barn paradox, faster than light effects (chapt. 1)
- Week 4: Relativistic momentum and energy (chapt. 2-1, 2-2, 2-3)
- Week 5: Inelastic collisions, 4-vectors, invariant mass (chapt. 2-1, 2-2, 2-3)
- Week 6: Introduction to curved space and general relativity (chapt. 2-5)
- Week 6: Exam 1
- Week 7: Quantization of charge, blackbody radiation (chapt. 3)
- Week 8: Photoelectric effect, Compton effect (chapt. 3)
• Week 9: Atomic spectra, Bohr model (chapt. 4)
• Week 10: X-ray spectra, Franck-Hertz experiment (chapt. 4)
• Week 11: Exam 2
• Week 11: De Broglie Hypothesis, wave packets, double slit experiment (chapt. 5)
• Week 12: Uncertainty principle, wave-particle duality (chapt. 5)
• Week 13: Schrödinger equation and simple solutions (chapt. 6)
• Week 14: Schrödinger equation: potential step, tunneling (chapt. 6)
• Week 15: Exam 3
• Week 15: Quantum harmonic oscillator (chapt. 6)
• Week 16: Hydrogen atom wave functions (chapt. 7)
• Week 17: Final May 15, 8:00-10:00 a.m.

Classroom expectations:
Students are expected to attend all classes except for valid excuses such as medical emergencies. Such excuses must be communicated to the instructor by email no later than the day following the missed class. If you miss at least four lectures without valid excuse or only partially attend them, you will automatically fail the course. Active participation in lectures and problem solving are essential. Students are expected to read the corresponding chapters in the text, to take detailed notes in class and to work through these notes after class. Material may be presented that is not in the text or it may be presented in a different way. Students are responsible for all material presented in class including that missed during excused and unexcused absences. Attendance at exams is mandatory unless excused for a valid University approved reason and if written and sufficient documentation of such a reason is presented to the instructor prior to the exam.

Black board:
Course assignments, course material and information will be posted to BlackBoard http://bb.ndsu.nodak.edu/. Additional information and notifications will be sent by email.

Homework:
Problem solving is the primary learning method for this course. Individual homework will be assigned every week and will be graded in detail. Group study and exchange of ideas (except during tests) are encouraged, however: every student has to hand in his/her own homework sheets with his/her own calculations. Simply copying someone’s work is considered cheating, therefore mostly identical sheets will receive zero points independent of who copied from whom. The problem solution should be turned in on 8 1/2” x 11 ” papers ONE SIDE ONLY, STAPLED together. SHOW all work. Clearly STATE basic assumptions and main ideas. Assignments will be typically given out on Tuesdays and are due on the following week’s Thursday at 9:30 a.m., that is, after 9 days. Handing in after the deadline will lead to zero points. Failure to timely hand in three assignments will result in automatic failure of the course. The three assignments with the lowest number of points will not be included in the grading.

Office hours, other help
The physics department has set up TA hours, where physics students will be available to help you. Students are encouraged to come to the office hours or to set up meeting times
with the instructor.

**Bonus: homework presentations and attendance**
At the beginning of the Thursday lecture, I will occasionally ask for volunteers who would like to present homework tasks on the board. These presentations will result in bonus points if they are correct. Incorrect answers will not have a negative impact on the grade, so give it a try. The idea is to encourage students to engage in scientific discussions and to get used to the idea of presenting results. Once in a while I might hand out attendance sheets which assign bonus points to all students present in class.

**Composition of final course grade:**
Final grades will be based on homework (40%), three exams (20% each), and the final exam (20%). One of the four exams including the final will be dropped. However, an unexcused missed exam will result in a score of zero, that is an exam absence without justification shall NOT be dropped. No make-up exams will be given and if an exam is missed for a valid excuse, it will be the score that is dropped. The exams will include conceptual questions, quantitative problems similar to the assigned homework problems and sometimes essay questions. The final exam will consist of problems requiring the application of principles learned throughout the course. The final is **mandatory** (unless you notify me in advance that you intend to drop it) and will be taken on Friday, May 15 from 8:00 to 10:00 a.m.

**Cheating on an exam will result in an F for the course.**
Final grades will be assigned by the following rule: A for 85% or above of the total points, B for 70 to 84.99%, C for 55 to 69.99%, D for 40 to 54.99%, and F for less than 40%. Depending on the class average, grades may be determined on a curve.

- 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 as soon as possible.
- 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.