PHYS222: Modern Physics
Spring 2014

Teacher: Dr. Kelly Krieble Office: Room 109, Collier Hall of Science Phone: ext. 1437 e-mail: krieblek@moravian.edu	Classroom: CHS 210A M,W,F 8:55-9:45am Th 8:55-9:45am Lab: CHS 107 M 1:00-4:00pm Office Hours: MWF 11-12

Course Texts: **Modern Physics for Scientists and Engineers**, 4th ed., Thornton and Rex.
Introduction to Relativity, Kogut
An Introduction to Error Analysis, 2nd ed., John R. Taylor

Course Objectives: The primary aim of this course is to provide students with a working knowledge of the concepts leading to the breakdown of classical physics and the emergence of modern quantum theory. The course material follows an historical approach, and contains a substantial experimental and writing component. Students will learn and develop mathematical and physical techniques for solving a wide range of problems. In the laboratory portion of the course students will learn about experimental design and gain experience using a variety of equipment for conducting physical measurements. This course satisfies the Writing Across the Curriculum requirement.

Course Content and Schedule of Topics:

Topic	*Approximate Time Span*	*Readings*
Relativity	4 weeks	Chapter 2
Scattering and diffraction a. Photon interactions b. Bragg diffraction c. Rutherford scattering	2 weeks	
Bohr Theory	1 week	Chapter 4
Quantization a. X-rays b. Franck-Hertz c. Wilson-Sommerfeld d. Harmonic oscillator	1.5 weeks	Chapter 3
Wave-Particle Duality a. DeBroglie wavelength b. Complimentarity c. Uncertainty principle	2 weeks	Chapter 5
Quantum numbers a. Schroedinger equation b. Angular momentum c. Energy splitting (Zeeman effect, etc.)	2 weeks	Chapters 6, 7, 8
Elementary particles and conservation laws	1.5 weeks	Chapter 14
Nuclear physics and radioactivity	2 weeks	Chapters 12, 13

Grading Policy:

A = 90%-100%
B = 80%-89%
C = 70%-79%
D = 60%-69%
F = below 60%

Assessment:	**% Weight**
Homework Problems	**20**
Lab Journal and Reports	**20**
Paper and Presentation	**10**
Exams	**30**
Final Exam	**20**

Homework Problems:

As illustrated above, the problem sets constitute a significant portion of your grade. Your work on these problem sets, as well as on lab reports and your paper, is subject to the Moravian College Policy on Academic Honesty. Refer to the Student Handbook or ask your instructor if you have any doubts or questions about any submitted work.

Due dates and late policy: Work submitted after the due date will receive a zero.

Labs:

To augment your overall learning experience and provide an experimental aspect to the course, you will be required to perform a lab roughly each week during the term – the weekly schedule for labs is given at the end of this document. To instill good laboratory report writing skills, lab reports will be submitted throughout the semester according to a prescribed format that follows the style of popular physics journals, using LaTeX software. Use of the Bedford writing handbook will be encouraged, and a copy will be available in the modern physics lab. Unless otherwise stated, the Physical Review Letters style will be used for all citations.

Students will also have the opportunity to peer review each other's work. For each lab report turned in, students must supply a second copy for peer review (comments and suggestions/corrections on grammar, format, content, style, and readability). Both copies will be returned and a revised report will be re-submitted by the student with the lab journal at the end of the semester. All originals and revisions shall be included in the portfolio. The student will also keep a laboratory journal throughout the semester, which includes notes, raw data, and calculations on the experiments performed during the course. Students will select an experiment they have performed to write-up as a formal article, and will create a poster and give a short presentation on their work to the class at the end of the semester.

Research Paper:

In addition to the lab reports, throughout the semester students will be researching a topic or personality in physics and will write a formal research paper (approximately 10-15 pages long). Assignments throughout the term will include: selecting a topic, producing a preliminary and final annotated bibliography, rough drafts, and writing the final draft of the paper.

Exams: At least three (in-class) one-hour exams during the semester.

Final comprehensive exam: An exam covering all material introduced during the semester.

Attendance Policy:

Students are expected to come to class, however sometimes issues beyond the student's control arise. Excused absences include but are not limited to medical problems, family emergencies, participation in sporting events, and the like. The instructor reserves the right to lower the student's grade should more than two unexcused absences accrue during the semester.

Good luck in the coming semester. Should you have any comments about the class during the semester, please feel free to discuss them with me.

Students who wish to request accommodations in this class for a disability should contact Elaine Mara, assistant director of learning services for academic and disability support at 1307 Main Street, or by calling 610-861-1510. Accommodations cannot be provided until authorization is received from the Academic Support Center.

The Writing Center is located in a building that is not accessible to persons with mobility impairments. If you need the services of the Writing Center, please call 610-861-1392.

Subject to Revision

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Date		Scheduled Topic/Lab
Monday	1/13	Introduction, Galilean Transform
Lab		**Interferometer**
Wednesday	1/15	Michelson-Morley experiment
Thursday	1/16	Einstein's postulates, simultaneity, train paradox
Friday	1/17	Lorentz Transformations
Monday	1/20	**No Class**
Lab		**No Lab – MLK Holiday**
Wednesday	1/22	Length Contraction and Time Dilation
Thursday	1/23	Problem Session
Friday	1/24	Relative velocity
Monday	1/27	Space-time diagrams
Lab		**MCAs and Relativistic Energy**
Wednesday	1/29	Relativistic Energy and momentum
Thursday	1/30	Problem Session
Friday	1/31	Collisions
Monday	2/3	Threshold energy
Lab		**Independent Labs**
Wednesday	2/5	Decay and Binding Energy
Thursday	2/6	Problem Session
Friday	2/7	JJ Thompson, Millikan, Planck

Monday	2/10	Photoelectric effect
Lab		**Exam #1 (Relativity)**
Wednesday	2/12	Photon Interactions
Thursday	2/13	Problem Session
Friday	2/14	Compton Effect
Monday	2/17	Crystal Structure
Lab		**Independent Labs**
Wednesday	2/19	Bragg diffraction
Thursday	2/20	Problem Session
Friday	2/21	Rutherford Scattering
Monday	2/24	Rutherford scattering
Lab		**Independent Labs**
Wednesday	2/26	Rutherford scattering
Thursday	2/27	Problem Session
Friday	2/28	Bohr Theory

SPRING BREAK

Monday	3/10	Spectral Lines and reduced mass
Lab		**Independent Labs**
Wednesday	3/12	Correspondence principle
Thursday	3/13	Problem Session
Friday	π	X-rays and energy level quantization

Monday	3/17	Wilson-Sommerfeld quantization
Lab		**Exam #2 (Particle/Wave Physics)**
Wednesday	3/19	De Broglie wavelength
Thursday	3/20	Problem Session
Friday	3/21	Complimentarity
Monday	3/24	Phase and group velocity
Lab		**Independent Labs**
Wednesday	3/26	Uncertainty principle
Thursday	3/27	Problem Session
Friday	3/28	Schroedinger equation
Monday	3/31	Infinite square well
Lab		**Independent Labs**
Wednesday	4/2	Hydrogen Atom, Angular momentum & quantum numbers
Thursday	4/3	Problem Session
Friday	4/4	Energy splitting and the g factor
Monday	4/7	Zeeman effect
Lab		**Independent Labs**
Wednesday	4/9	Anomalous Zeeman effect and Lande g
Thursday	4/10	Problem Session
Friday	4/11	Elementary Particles
Monday	4/14	Conservation Laws
Lab		**Exam #3 (Quantum Physics)**
Wednesday	4/16	Nuclear Physics

Easter Break

Monday	4/21	Fission
Lab		**Presentations**
Wednesday	4/23	Fusion
Thursday	4/24	Problem Session
Friday	4/25	Semester Review
Tuesday	4/29 (8:30am)	**Final Exam**