

UNIVERSITY OF CALGARY  
DEPARTMENT OF PHYSICS and ASTRONOMY  
**COURSE OUTLINE**

**1. Physics 325, Modern Physics II**

**L01:** MWF 9:00 – 9:50, ST130

Dr. M. Wieser  
Office: SB 131  
Telephone: 403-220-3641  
Office Hours: TBA  
Email: mwieser@ucalgary.ca  
Main Physics and Astronomy Office: SB 605, 403- 220-5385

Blackboard course name: Phys 325 L01 – (Winter 2012) – Modern Physics II

- 2. PREREQUISITES:** Physics 211 or 221 or 227 and 223 or 255 or 259 or 355 and Mathematics 211 or 213 (Please see Calendar Description for more information).
- 3. GRADING:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

25 % Laboratory Reports  
5 % Poster Presentation (To be held during the week of April 9)  
20 % Assignments  
30 % Midterm Examinations (Two at 15 % each on February 17 and March 23)  
20 % Final Exam (To be scheduled by the Registrar)

A passing grade on the final examination is required in order to pass the course.

Percentage grades will be given for all elements of term work and examinations in Physics 325. A weighted course percentage will be calculated for each student after the final exam is written. A table of conversion from final course percentage to final course letter grade will be published on the Phys 325 Blackboard site later in the term.

- 4. Missed Components of Term Work.** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in section 3.6: <http://www.ucalgary.ca/pubs/calendar/current/sc-3-6.html>. It is the student's responsibility to familiarize himself/herself with these regulations. See also <http://www.ucalgary.ca/pubs/calendar/current/e-3.html>.
- 6. TEXTBOOK:** "Modern Physics for Scientists & Engineers ", 2<sup>nd</sup> Edition, JR Taylor, CD Zafiratos, MA Dubson, Prentice-Hall
- 7. EXAMINATION POLICY:** All examinations are closed book. A formula sheet will be provided. Programmable calculators are permitted. Students are encouraged to read the Calendar, Section G, on Examinations: <http://www.ucalgary.ca/pubs/calendar/current/g.html>.
- 9.** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also <http://www.ucalgary.ca/pubs/calendar/current/e-2.html>.

Department Approval \_\_\_\_\_ Date \_\_\_\_\_

Associate Dean's Approval for  
out of regular class-time activity: \_\_\_\_\_ Date: \_\_\_\_\_

**11. OTHER IMPORTANT INFORMATION FOR STUDENTS:**

- (a) **ACADEMIC MISCONDUCT** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under K. Student Misconduct (<http://www.ucalgary.ca/pubs/calendar/current/k.html>) to inform yourself of definitions, processes and penalties.
- (b) **ASSEMBLY POINTS** in case of emergency during class time. Be sure to **FAMILIARIZE YOURSELF** with the information at <http://www.ucalgary.ca/emergencyplan/assemblypoints>.
- (c) **ACADEMIC ACCOMMODATION POLICY.** Students with documentable disabilities are referred to the following links:  
Calendar entry on students with disabilities: <http://www.ucalgary.ca/pubs/calendar/current/b-1.html>  
Disability Resource Centre: <http://www.ucalgary.ca/drc/>.
- (d) **SAFEWALK:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call **220-5333** for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **FREEDOM OF INFORMATION AND PRIVACY:** This course will be conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, **students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page.** For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **STUDENT UNION INFORMATION:** VP Academic **Phone:** 220-3911 **Email:** [suvpaca@ucalgary.ca](mailto:suvpaca@ucalgary.ca).  
SU Faculty Rep. **Phone:** 220-3913 **Email:** [sciencerep@su.ucalgary.ca](mailto:sciencerep@su.ucalgary.ca) Website <http://www.su.ucalgary.ca>  
Student Ombudsman: <http://www.su.ucalgary.ca/services/student-services/student-rights.html>
- (g) **INTERNET and ELECTRONIC COMMUNICATION DEVICE Information.** You can assume that in all classes that you attend, **your cell phone should be turned off.** Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

# Course Syllabus

Origins of quantum mechanics, a historical perspective. Concepts of wave mechanics and applications. Nuclear physics and radioactivity. The aim of the course is to survey some of the significant challenges to classical physics encountered in the 20th century and to show how the solutions to these phenomena shaped our understanding of the natural world. Quantitative problem solving will be emphasized as a means of gaining deeper understanding of the concepts. The laboratory is considered a very essential component of the course where students will get a “hands-on” sense of some of the phenomena studied.

## Assignments

There will be six assignments throughout the term. The assignments will be distributed via the course blackboard website. Your solutions must be handed in at the start of the lecture on the due date.

## Laboratory Reports

The laboratory component of Phys325 is an essential opportunity for you to experience some of the exciting phenomena encountered in this course. A laboratory manual will be available on-line at [www.pjl.ucalgary.ca](http://www.pjl.ucalgary.ca). Two of the laboratory reports will be submitted as group project and in a format similar to that required for a Physics journal. The details of the format will be discussed in the lectures later in the term. In the case of the group report, the same grade will be applied to all members of the group.

Each laboratory exercise is accompanied by “Pre-lab Questions”. You must read over the laboratory exercise and complete these questions prior to entering the laboratory and working on the experiment. Your TA will check that these questions are complete at the start of the session.

In the final half of the course, you must complete three mandatory experiments (Compton Scattering, Nuclear Decay, and Rutherford Scattering) and two experiments chosen from a list of three (Blackbody Radiation, Colour Temperature, or Photoelectric Effect). Your laboratory TA will work with you to make the selection and coordinate when you perform a particular experiment. Experiments including Nuclear Decay and Rutherford Scattering require several days to complete and a limited amount of time outside of your scheduled laboratory section may be needed to complete each experiment.

## Poster Presentation

You and your group will select one experiment to present in the form of a poster during a *Symposium on Experiments in Modern Physics* that will be held during the week of April 11<sup>th</sup>. The exact date and time will be decided during the term. The poster presentation will last approximately two hours during which time you and your group members will discuss your results and conclusions with your peers and other members of the department. Laboratory TAs and the course instructor will grade your work and your response to questions. Strategies for designing an effective poster as well as the criteria for grading will be discussed in the lectures. The same grade will be applied to all group members.

**Tentative lecture schedule for Winter 2012**

<b>Date</b>	<b># Lectures</b>	<b>Topics</b>	<b>Textbook Section</b>
Jan 09 – Jan 20	6	Special Theory of Relativity: Einstein's postulates and consequences, Time Dilation, Length Contraction, Simultaneity, Lorentz Transformations, Conservation of Relativistic Momentum and Energy	1.1 – 1.12; 2.1 – 2.9
Jan 23 – Jan 30	4	Subatomic particles, Electromagnetic Radiation, Blackbody radiation, Photoelectric Effect, X-rays and Bragg Diffraction, Compton Scattering	3.1 – 3.6; 3.10; 3.12 4.1 – 4.7
Feb 01 – Feb 06	3	Atomic Structure, Rutherford Scattering Experiment, The Bohr Model, Atomic Spectra	5.1 – 5.10
Feb 08 – Feb 15	4	DeBroglie's Matter Waves, Probability Density, Heisenberg Uncertainty Principle	6.1 – 6.9
Feb 17		MIDTERM #1	
Feb 20 – Feb 24		READING WEEK – No Lectures	
Feb 27 – Feb 29	2	The Schrödinger Wave Equation, Operators, Expectation Values	7.1 – 7.5
Mar 2 – Mar 7	3	Applications of the Schrödinger Wave Equation: Rigid Box/Potential Wells/Harmonic Oscillator, Tunneling Phenomena	7.6 – 7.10
Mar 9 – Mar 12	2	Three Dimensional Schrödinger Wave Equation and Degeneracy	8.1 – 8.3
Mar 14 – Mar 21	4	The Hydrogen Atom, Energy Levels and Radial Probability Density, Quantization of Angular Momentum	8.4 – 8.10
Mar 23		MIDTERM #2	
Mar 26 – Mar 30	3	Electron Spin, Zeeman Line Splitting, Pauli Exclusion Principle, Electronic Transitions	9.1 – 9.7
Apr 2 – Apr 13	6	Radioactivity, Nuclear Stability and Nuclear Decay, Alpha, Beta, and Gamma Decay, Natural Decay Chain, Fission and Nuclear Reactors, Nucleosynthesis, Geochronology	16.1 – 16.4; 16.7 – 16.9; 17.1 – 17.10
Week of April 09		Poster Presentation: Time and Date to be determined	

**Books that may be of interest**

Modern Physics for Scientists and Engineers, 2nd edition  
John Taylor, Chris Zafiratos, and Michael Dubson  
Pearson / Addison Wesley  
ISBN-10: 0-13-805715-X

Modern Physics 2nd Edition (or now 3<sup>rd</sup> Edition)  
Raymond Serway, Clement Moses, and Curt Moyer  
Harcourt College Publishers  
ISBN-10: 0-03-001547-2

Quantum Theory: A Very Short Introduction  
John Polkinghorne  
Oxford University Press  
ISBN-10: 0-19-280252-6

Quantum Theory: A graphic Guide to Science's Most Puzzling Discovery  
J. P. McEnvoy  
Totem Books  
ISBN-13: 978-1840468502