WILFRID LAURIER UNIVERSITY

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Course Syllabus

PC242 Modern Physics

Department of Physics and Computer Science, Faculty of Science, Waterloo Campus

Winter | Year 2020

Instructor Information

Marek S. Wartak | Office N 2076 D

Contact Information (x. 2436/mwartak@wlu.ca)

Weekly Office Hours (M 2:00 -3:00 pm) or by appointment

Course Information

The course covers fundamental topics in modern physics with extensive focus on applications. Students will learn how modern physics works, and are given the opportunity to show what they have learned by testing their understanding of the concepts and applying them to real-world scenarios.

In general, the following issues will be discussed in details.

Failure of classical physics and early quantum theory, blackbody radiation and Planck's theory, the photoelectric effect and light quanta, wave particle duality, Compton scattering, De Broglie and matter waves, Davisson and Germer experiment, energy quantization, Bohr's theory of hydrogen, topics in atomic theory and the periodic table, X-ray spectra, molecules, phenomenological description of solids, Fermi statistics, conduction, semiconductors, energy bands. Nuclear physics, radioactivity, and modern particle physics, accelerators. Relativity.

Credit: 0.50

Prerequisite: PC131, PC132, (or PC141, PC142), MA205.

Course location: MWF 10:30-11:20 am in N1059

Course Overview and Approach

After taking this course you will, among other things, be able to:

- understand the basic concepts of modern physics
- have learned the historical steps that led to the modern scientific evolution in physics, the basic ideas of and the current issues behind research in modern physics.
- Proficient students will have acquired a sufficient knowledge to understand at deeper level science divulgation and introductory research material and some of the current issues behind contemporary research in physics.

The course is structured in terms of thematic units which will help students study in a fair detail and understand the most important aspects of modern physics. The course is lecture based. During each class students will be able to ask questions if they need more clarification. After the lecture I would expect students to have at least basic understanding of the most important parts of the topics discussed.

Course Goals and Learning Outcomes

Through your work in this course, you will acquire an introductory but firm understanding of concepts and techniques in relativistic dynamics, quantum mechanics and some applications.

- we will apply this understanding and these techniques to physical problems,
- you will broaden and deepen your physical and mathematical problem solving skills.

Course Tools and Learning Materials

Principal course textbook is:

R.A. Serway, C.J. Moses, C.A. Moyer, "Modern Physics", Third Edition, Thomson, Brooks/Cole, Belmont, CA 2005.

Student Evaluation for PC242

Assessment	**Weighting**
Quizzes	25%
Exams (3x)	25% each
Total	**100%**

Notes

QUIZZES: There will be list of homework problems distributed in class. The list will be made up of problems from the end of each chapter. Homework will not be collected. Instead, a 10 min closed-book quiz will be given at the end of a lecture after the chapter material has been finished. The quiz will consist of one of the homework problems.

Tentative Weekly Schedule

Week # and dates	Topic	Lesson outcomes and learning activities
Week 1. Jan.6-Jan.10	General info. Relativity I.	Discussion of syllabus. Lorentz transformation
Week 2. Jan.13 - Jan.17	Relativity II.	Relativistic Newton's second law
Week 3. Jan.20- Jan.24	The quantum theory of light.	Early experiments
Week 4. Jan.27 - Jan.31	The particle nature of matter.	Bohr's theory
Week 5 Feb.3 - Feb.7	Matter waves.	Early quantum mechanics
Week 6. Feb.10- Feb.14	Quantum mechanics in one dimension.	Schroedinger equation
Feb.17- Feb.21	Reading Week.	No classes
Week 7. Feb.24 - Feb.28	Tunneling phenomena.	Applications. Tunneling
Week 8. March 2 - March 6	Quantum mechanics in three dimensions.	Applications. Hydrogen atom
Week 9. March 9 - March 13	Atomic structure.	Applications. Atomic structure
Week 10. March 16 - March 20	Statistical Physics.	Fundamentals of statistical physics
Week 11. March 23 - March 27	Molecular Structure.	Elements of chemistry and solid state
Week 12. March 30 - April 3	The Solid State.	Fundamentals of solid state physics

University and Course Policies (proposed and required text)

Laurier has several senate approved policy statements it requires instructors to include in their syllabus. Those with specific wording approved by senate are indicated specifically below.

1. **Academic Calendars:** Students are encouraged to review the Academic Calendar for information regarding all important dates, deadlines, and services available on campus.

2. **Special Needs:** Students with disabilities or special needs are advised to contact Laurier's Accessible Learning Centre for information regarding its services and resources.

3. **Plagiarism:** The University has approved the following wording for inclusion on all course syllabi about the use of the institutionally supported plagiarism software tool. "Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by the instructor, students are required to submit their written work in electronic form and have it checked for plagiarism." (Approved by Senate May 14, 2002) .

   In addition to the statement above you may wish to add the following text about academic integrity.

4. **Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. Together, we have a shared responsibility to uphold this culture in our academic and nonacademic behaviour. The University has a defined policy with respect to academic misconduct. As a Laurier student you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. The relevant policy can be found at Laurier's academic integrity website along with resources to educate and support you in upholding a culture of integrity. Ignorance is not a defense.

5. **Classroom Use of Electronic Devices:** State your classroom practice and any consequences for student failure to comply – see Policy 9.3 (Approved by Senate March 8, 2012).

6. **Late Assignment Policy:** Specify any penalties that will be assessed when deadlines for the completion of course components are not met (Approved by Senate May 23, 2012). Refer to the Handbook on Undergraduate Course Management for more information.

7. **Final Examinations:** Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students are required to be available for examinations during the examination periods of all terms in which they register. Refer to the Handbook on Undergraduate Course Management for more information.

8. **Foot Patrol, the Wellness Centre, and the Student Food Bank:** The University approved the inclusion of information about select wellness and safety services and supports on campus in the course information provided to students. (Approved by Senate November 28, 2011.) Specific language (by campus) is provided below.

   Multi-campus Resource:

- Good2Talk is a postsecondary school helpline that provides free, professional and confidential counselling support for students in Ontario. Call 1-866-925-5454 or through 2-1-1. Available 24-7.

Kitchener/Waterloo Resources:

- Waterloo Student Food Bank: All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.

- Waterloo Foot Patrol: 519.886.FOOT (3668). A volunteer operated safe-walk program, available Fall and Winter daily from 6:30 pm to 3 am. Teams of two are assigned to escort students to and from campus by foot or by van.

- Waterloo Student Wellness Centre: 519-884-0710, x3146. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2nd floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays and Fridays from 8:30 am to 4:15 pm. Contact the Centre at x3146, wellness@wlu.ca or @LaurierWellness. After hours crisis support available 24/7. Call 1-844-437-3247 (HERE247).

Brantford Resources:

- Brantford Student Food Bank: All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.

- Brantford Foot Patrol: 519-751-PTRL (7875). A volunteer operated safe-walk program, available Fall and Winter, Monday through Thursday from 6:30 pm to 1 am; Friday through Sunday 6:30 pm to 11 pm. Teams of two are assigned to escort students to and from campus by foot or by van.

- Brantford Wellness Centre: 519-756-8228, x5803. Students have access to support for all their physical, emotional, and mental health needs at the Wellness Centre. Location: Student Centre, 2nd floor. Hours: 8:30 am to 4:15 pm Monday through Friday. After hours crisis support available 24/7. Call 1-884-437-3247 (HERE247).