Physics 222

Instructor: Bret Hess
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Office Hours: T, Th 1:00-1:50 p.m.

Teaching Assistants:

Class website: physics.byu.edu then Courses, then 222

Physics 222 is an introduction to modern physics. Modern physics is based upon the two major theories discovered in the twentieth century, quantum mechanics and relativity. Since relativity is covered in Physics 123, we will focus on quantum mechanics.

Objectives:

• Learn the fundamental concepts that govern quantum mechanics, i.e., physics at very small length scales.
• Review the history of the development of these ideas as classical physics was shown to break down in many cases.
• Apply the fundamentals of quantum mechanics (and some relativity) to understand the basics of particle, nuclear, atomic, and condensed matter physics.
• Combine the conceptual understanding with quantitative analytical skills to calculate and explain properties of simple quantum systems in the above fields.
• Improve scientific research and writing skills and build on the understanding gained in the course by writing two papers: 1) research and explain in depth the historical development of a theory, experiment or technology in an area of current interest in quantum mechanics, and 2) present the modern understanding of the field.
• Learn to solve problems, write and study in a group setting.

Physics 121, 123, 220 or approved equivalents should be taken before this course. Students will also be expected to be very familiar with the mathematical methods used in the prerequisite courses.

Textbook: The text is Concepts of Modern Physics, 6th Edition by Beiser. The reading assignment for each lecture is listed on the class schedule. You will be quizzed on the assigned reading material. It is very important that you read the assigned sections before class discussion of the material.

Lectures and Help Sessions: This class meets every day. On Mondays, Wednesdays, and Fridays we will hold regular lectures. On these days new material will be discussed, class announcements will be made, and quizzes will be given. On Tuesdays and Thursdays you will work on homework as a group in a tutorial lab atmosphere with the TAs.

CID Numbers: You must obtain a class ID number. If you did not receive your CID number by email, go to: http://gardner.byu.edu/cid/. You can check your scores online with your CID number.
Homework:
You must complete most of the homework to pass this class. There will be an assignment due at ESC building closing time almost every Wednesday and Friday.

Students will be organized in groups of about three for homework and papers. On Tuesday and Thursday, the groups will meet in the help session to work and discuss homework. You can work on the homework individually as well, but each group probably needs to find some time outside of class for each assignment to agree on the solutions and combine their work into a single submission. Some groups prefer to meet before the help session so they know where they are stuck and can get those questions answered.

If you have been excused by me (by email) to miss group work because of some emergency, record the actual percentage of group time you put in with the group, attach a copy of my email to your work and turn it in, and you can receive full credit for the group portion.

Use a group homework cover sheet. It includes the group number, the names of the students, and the percentage of time each person worked on the homework with your group (100% means you didn’t miss any group work time). The assignment should be placed in the slot labeled "Physics 222" in the boxes near room N375 ESC.

When your grade is computed at the end of the semester, your two lowest homework scores will be dropped. **Late homework will be discounted 5% per hour.**

Homework must be legible, and all steps must be clear to get full credit. All homework should be done symbolically as far as possible. When numerical results are required, please do not put numbers into equations until the end. Unless otherwise noted, numerical answers should be given in standard SI (mks) units to three significant digits.

Exams: There will be three midterm exams during the semester and a final exam during finals week. Midterm exams will be given in the testing center. There will be a three hour time limit. The final exam will be given in the classroom at the date and time given above. The final exam will be comprehensive. For each exam, you will be allowed one half 8 1/2" x 11" page (one side) of hand written (written by you, not photocopied) notes and an un-programmed calculator. You will be provided with the most relevant equations on the exam.

Quizzes and class participation: Several quiz and thought questions will be presented during each lecture.

Quiz questions will be simple questions designed to find out if you have done the reading and paid attention to what you’ve read. Correct answers are worth 1 point.

Conceptual practice questions are for extra credit are designed to have you discuss and try concepts we have discussed. Practice questions are worth three if correct, and one if incorrect (participation).
These points will be recorded on a Quiz Record Sheet. You will submit your totals on a Quiz Reporting Form every seven weeks. I suggest you write your daily totals in another safe place so that you don’t lose the information before it is recorded.

Quizzes and participation points cannot be made up (except under extreme circumstances). To allow for the possibility that some students may have to miss lectures for good reasons, you are allowed to convert three daily quiz scores for which you lost the most points to perfect scores, but it must be made before the particular Quiz Reporting Form is turned in.

**Papers:** Your group will write two short papers. See the Writing Assignments document at the end of this syllabus. Both papers are related to a single topic in physics you will choose as a homework group. In the first paper, you will present a view of the historical development the ideas, theory or technology in the topic you have chosen. It can include the development of ideas, as well as insights into the humanity and experience of the people involved. In the second paper you will write about the physical concepts behind your topic in depth, and present the current understanding or state-of-the-art of the topic.

These assignments are very important, and will be responsible for a significant part of your grade. In addition to giving you the chance to learn more about a topic in quantum mechanics, these assignments are intended to improve your writing skills. You must post each part of the assignment on Blackboard by the deadline. Any late work will be discounted 5% for every hour it is late.

**Read the requirements and grading criteria carefully** in the Writing Guidelines found on the website.

**Grading:** Your scores will be recorded and available online. Your letter grade will be determined from your total percentage, according to the breakdown below. The weights given to the various assignments are as follows:
20% Homework, 45% Exams, 18% Final, 5% reading quizzes, 12% Papers. 5% extra credit possible from class participation.

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Writing Assignments

You will be required to complete two writing assignments. Both assignments are related to a topic in physics you will choose as a homework group.

See examples of excellent and mediocre papers on the website from past semesters.

In the first paper, you will present a view of the historical development the ideas, theory or technology in the topic you have chosen. It can include the development of ideas, as well as insights into the humanity and experience of the people involved. The first paper’s length is approximately 2 pages per person in the group (double spaced), in addition to figures (approx. 800 words per person).

In the second paper you will include your revised material from the first paper as the introduction, and also write about the physical concepts behind your topic in depth, and present the current understanding or state-of-the-art of the topic (two pages more per person). So this paper’s length is approximately 4 pages per person in the group (double spaced), in addition to figures (approx. 1600 words per person), but only half of it is new.

Topic choice
The topic should be related to some application of quantum mechanics to science or technology. It should be an area that is currently researched, and whose history you can trace. For ideas, see the index of your text, links provided on the website, and any other sources you can find. One easy strategy is to go to the AIP’s Physics News Update or Physics Web links on the webpage, then choose December of a given year. See the Top Stories or Highlights for that year. News of the last 15 years will give you something recent enough to write on (although you will need to bring it up to date). Look for articles that sound interesting that involve quantum mechanics. Topics on materials at the microscopic level (superconductors, semiconductors), topics with "quantum" in it, nuclei, novel subatomic particles (quarks, neutrinos, gluons,...). If you want to do something with astronomy or cosmology, there are plenty of topics that involve quantum mechanics or subatomic particles (string theory, supersymmetry, quantum gravity, cosmic rays, and astrophysical models). If you are unsure that the idea is appropriate, please check with Dr. Hess before preparing and submitting the topic proposal.

1. Topic Proposals (10 points): Before writing each of your term papers, you will write a proposal. This will allow me to make sure that you are on the right track and know how to find the required resources. The proposal should be about two pages long.

For the first proposal (historical development), on page 1 you will briefly describe the topic (the fundamental principles involved, and a brief description of the history), and why you are interested in it. On page 2 you will list the literature (books, articles, etc.) which you have found on the historical development of the subject and briefly describe (1-2 sentences) what each of these resources contains.
For the second proposal, on page 1, make a detailed outline (in outline form…1., 2., A. B., etc) for the second paper you are proposing. On page two, list the literature (books, articles, etc.) that you have found on the state of the art in this subject. Points will be deducted if any of the above mentioned items are missing, if the proposal does not convince me that you have done a significant amount of preparation and study on the topic, or if the proposal is poorly written.

2. Draft for Peer Review (10 points): Your group will post a polished draft of your paper for peer review on the date indicated in the class schedule. Another group will review it. They will make comments and suggestions to improve your paper. I will look at each paper to see that it represents a polished draft.

3. Review of another group’s Paper (15 points): Your group will be assigned another group’s paper to review. By the deadline indicated in the schedule you post a critique of this paper.

   Address each question by number:
   1) What do you like most about the paper?
   2) Is the main point of the paper clear?
   3) Does the paper make you think?
   4) What makes the paper interesting or catches your attention?
   5) Do any paragraphs or sentences stray from the main idea?
   6) Where do you get lost or confused?
   7) Is the paper’s topic too broad or too narrow?
   8) Is the paper too technical to follow or too simplistic?
   9) Does the paper flow well? How well is it organized?
  10) Is the paper scientifically correct?
  11) Does the paper use proper grammar and spelling? (Do not list the errors…just judge the quality of grammar and spelling).
  12) Are there any missing or improperly done references? (Do not list the errors…just judge the correctness of the references).
  13) Does the paper have an appropriate abstract, introduction, and conclusion?

Remember that different authors have different styles, and be sure to point out things that you like. But say what you think --- being able to accept criticism and make changes is one of the most important skills a writer can develop.

I will grade this review on completeness. Make a serious review.

4. Draft for Writing Fellows Review (5 points): After receiving a critique from a fellow group, you should make any necessary changes, and make another pass at polishing and refining your paper. You will then post the paper to be reviewed by one of the writing fellows assigned to our course. The writing fellows are students who have received special training to help you with your writing.

Grading will be based on posting on time.
5. **Writing Fellow Conference (10 points):** After the writing fellow has reviewed your paper, you will set up an appointment to meet with them to discuss your paper. If you attend this conference, you will receive the full 10 points.

6. **Final Draft (50 points):** The last part of your assignment is to post the final draft. I will read your papers, and grade them according to the [Writing Guidelines](#) found on the web page.

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**University Policies**

**Preventing Sexual Harassment**
BYU’s policy against sexual harassment extends not only to employees of the university but to students as well. If you encounter sexual harassment, gender-based discrimination, or other inappropriate behavior, please talk to your professor, contact the Equal Employment Office at 422-5895 or 367-5689, or contact the Honor Code Office at 422-2847.

**Students With Disabilities**
BYU is committed to providing reasonable accommodation to qualified persons with disabilities. If you have any disability that may adversely affect your success in this course, please contact the University Accessibility Center at 422-2767. Services deemed appropriate will be coordinated with the student and instructor by that office.

**Honor code:** The honor code can be found at [http://www.byu.edu/stlife/campuslife/honorcode/](http://www.byu.edu/stlife/campuslife/honorcode/). Of course we expect the highest standards of honesty and kindness in our class.