

Arts & Science 2D06: Physics – Course Outline

2016/17

Instructor: Prof. Alan Chen, Department of Physics and Astronomy

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Office Hours: Mondays and Wednesdays, 9:30am – 10:30am

Class Times: Mondays and Wednesdays, 11:30am – 12:20pm, ABB 271
Fridays, 1:30pm – 2:20pm, ABB 271

Required material:

- **Textbook:** Giancoli, Physics for Scientists and Engineers with Modern Physics, 4th Edition
- **Calculator:** McMaster standard calculator (CASIO fx991) – to be used for all quizzes and exams – available in the campus bookstore.

Tutorials, run weekly by the teaching assistants, will provide opportunities to practice problem-solving in a smaller group environment.

Teaching Assistants: Ashley Bemis (Term 1), bemisa@mcmaster.ca
Nathan Brunetti (Term 2), brunettn@mcmaster.ca
Sarah McKenzie-Picot (Terms 1 & 2), mckens2@mcmaster.ca

Tutorial Times: Mondays, 12:30pm – 1:20pm, GS 101
Tuesdays, 1:30pm – 2:20pm, BSB 121

After classes begin, a **website** will be used throughout the term for posting schedules, information, suggested problem sets from the textbook, last year's quizzes, historical links, etc. Here's the link: <http://www.physics.mcmaster.ca/~chenal/2D06/>

Bookmark it and check it out weekly.

The website also contains links to other websites for readings on the history of physics and the development of ideas. Some of these will be required reading and will be mentioned at appropriate times during the course.

Marking scheme:

25% April exam

24% December exam

20% In-class quizzes (best 6 of 7 scheduled quizzes; 3.5% each for total of 21%)

21% Laboratory work (2 major projects, one each term, and one class presentation)

10% Participation (e.g., project presentation days, in-class discussions)

The December and April exams and all laboratory work must be completed to pass the course.

The final percentage grade will be converted by the standard McMaster conversion scale:

12 = 90 – 100%	11 = 85 – 89%	10 = 80 – 84%
9 = 77 – 79%	8 = 73 – 76%	7 = 70 – 72%
6 = 67 – 69%	5 = 63 – 66%	4 = 60 – 62%
3 = 57 – 59%	2 = 53 – 56%	1 = 50 – 52%
0 = 49% or less		

Students should keep a copy of anything handed in for marking (such as a project report).

Missed Quizzes

There will be no re-weighting of marks to accommodate missed work. Students who submit MSAFs for quizzes will be required to write a make-up quiz, which will be different from the missed one but of comparable level of difficulty and same coverage of material. For a given quiz, one make-up quiz session for all students will be held in C-105 or in ABB.

Outline of Curriculum and Objectives

Course Objectives:

- To identify and discuss the underlying ideas, principles, and natural laws that describe a wide range of phenomena in the outside physical world: motion, forces, gravity, waves, fluids, light, space and time, quantum mechanics.
- To probe how scientific thinking and the progress of science is built on the twin principles of measurement and modeling.
- To study the historical development of the ‘great ideas’ in physics as developed by Archimedes, Galileo, Newton, Einstein, Bohr, de Broglie, Schrödinger, Heisenberg, and others; and to see how these ideas have influenced Western cultural history.

Outline for Term I:

- Newtonian Mechanics: Motion (kinematics) in one and two dimensions. Forces and Newton’s three laws of mechanics. Friction, circular motion. Work, kinetic energy, potential energy, conservation of energy. Momentum and collisions. Rotational motion.
- Special Relativity: The speed of light, time dilation, length contraction, simultaneity, the Lorentz transformation. Momentum and energy in special relativity.

Outline for Term II:

- Fluid mechanics, hydrostatics, Archimedes’ principle, Bernoulli’s principle.
- Simple harmonic motion, wave motion, interference and diffraction of light.
- Quantum mechanics: early atomic theory, waves and probability, the uncertainty principle, the Schrödinger equation.
- General Relativity: the equivalence principle, curved space, black holes.

Arts & Science 2D06 – 2016/17 – Estimated Weekly Schedule – Term 1

Week	Beginning	Topic
1	Sep 5	One dimensional kinematics
2	Sep 12	One and Two dimensional kinematics
3	Sep 19	Forces, Newton's Laws <i>[Quiz #1 – Fri – Sep 23]</i>
4	Sep 26	Newton's laws of motion
5	Oct 3	Work, kinetic energy
6	Oct 10	MID-TERM RECESS
7	Oct 17	Potential energy; energy conservation <i>[Quiz #2 – Wed – Oct 19]</i>
8	Oct 24	Momentum
9	Oct 31	Momentum conservation
10	Nov 7	Momentum conservation, special relativity <i>[Quiz #3 – Wed – Nov 9]</i>
11	Nov 14	Special relativity
12	Nov 21	Special relativity
13	Nov 28	Project presentations <i>[Quiz #4 – Wed – Nov 30]</i>
14	Dec 5	Project presentations

Arts & Science 2D06 – 2016/17 – Estimated Weekly Schedule – Term 2

Week	Beginning	Topic
1	Jan 2	Fluid mechanics: hydrostatics
2	Jan 9	Fluid mechanics: fluids in motion
3	Jan 16	Simple harmonic motion
4	Jan 23	Wave motion and wave phenomena <i>[Quiz #5 – Wed – Jan 25]</i>
5	Jan 30	Interference phenomena in light
6	Feb 6	Interference of light
7	Feb 13	Historical quantum mechanics <i>[Quiz #6 – Wed – Feb 15]</i>
8	Feb 20	MID-TERM RECESS
9	Feb 27	Quantum mechanics and the atom
10	Mar 6	Uncertainty principle and other quantum ideas
11	Mar 13	Finish quantum mechanics <i>[Quiz #7 – Fri – Mar 17]</i>
12	Mar 20	General relativity
13	Mar 27	General relativity + Project presentations
14	Apr 3	Project presentations

Arts and Science 2D06 - 2016/17

Independent Term Projects

The laboratory component of Arts and Science 2D06 this year consists of two independent term projects. In total these count for 21 % of the course grade. This is subdivided as follows:

- Write-up for Term I project: 8 %
- Write-up for Term II project: 8 %
- Class presentation (one to be done in either term): 5 %

Given below is a long list of options for project ideas which you can choose from. You will do two of these: one in Term I and another one in Term II (the project lists are conveniently separated by term).

Rather than selecting from the lists below, you can devise your own project. See me or your TA if you have other ideas. In addition, you will take one of your two term projects and prepare a class presentation for it. Choose which one, and schedule a time for your presentation, by meeting with me.

The presentation should be 10 minutes long, plus a 5-minute period afterward for questions and general discussion with the class. Use any approach you like, but don't build it around Power Point or video presentations.

The ground rules for the projects are simple:

- Find one partner (i.e., no teams of 3).
- Select a term project from the list on the course website. Develop an outline for how you want to do it. Then see your assigned TA to discuss the experimental approach you want to take.
- Each project on the list can be done by at most two teams. That is, you can do the same project that some other team is working on, but remember, you will be graded on how distinctive and interesting your approach is.
- Design and carry out the experiment.
- Prepare a write-up as a team and hand it in by the deadline that you have been assigned.

Doing Your Experiment:

You will see that the outlines for the suggested projects (given below) are very much less detailed, formalized, or constrained than in a typical "lab manual". Often they are nothing more than a suggestion. You will need to work out your own method and put together your own apparatus where necessary (and the simpler the better). Most of the projects are also open-ended and can be pursued in a variety of ways. All of them will work; but it's up to you to make them work. Experiments are about measurement -- an oscillation period, a fluid flow rate, a falling time -- whatever it is you are aiming for. Your emphasis should be on running a simple experiment to get a series of measurements, and not on trying to build something complicated. The end point is the measured data, not the apparatus. (To put it another way -- this is supposed to be physics, not engineering!) What pitfalls and warnings should you be aware of? Here are a few brief items:

Probably the most common problem that people run into with these independent projects is to not give themselves enough lead time to do it. Your experimental setup probably won't quite work the way you wanted it to when you designed it on paper. Things will go wrong. One working session between you and your partner won't be enough; plan for more. This is very typical of real-world experiments! Give yourself enough time to change things around, use trial and error, and finally get something that works the way you imagined it would.

Probably the second most common problem is to plan the experiment but then run the whole measurements not quite knowing exactly how you are going to analyze the numbers afterward. Don't say to yourselves, "We'll just collect all our data now and figure it all out later". This is almost guaranteed to get you into trouble -- and if you are discovering this the night before your write-up is due, you're sunk. It's better to do one trial run of the experiment, then take the measurements and go all the way to the end of the calculations you need to do afterward. Things will come up that you didn't predict, and you can then go back and fix it. (And of course you will also understand your experiment a whole lot better.)

For a few suggested projects, safety may be an issue. Be aware of the risks ahead of time and plan your experiment accordingly. Make sure that neither you nor innocent bystanders will get hurt, and that no property damage occurs.

Writing It Up:

Your write-up does not need to be in any specific format -- organize it how you wish. However:

- It should be no more than about 8 pages in length (not including graphs or illustrations).
- It should carefully document any resources from other texts, the published literature, the internet etc. that you used in developing your experiment.
- It should document which of you did what parts of the work.
- It should contain photos of your apparatus and your experiment in action.

The due date for your written report in Term I is **Wednesday, November 23**, before 5 PM in my office. If you hand in your write-up on November 22 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after November 24 will have a per-day 2-mark penalty applied.

The due date for your written report in Term II is **Wednesday, March 22**, before 5 PM. If you hand in your write-up on March 21 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after March 23 will have a per-day 2-mark penalty applied.

Evaluation of your Write-up and Presentation:

Your written reports will be marked on these criteria:

- Originality of approach and quality of experimental design.
- How deeply you investigated the question and understood the physics involved.
- Quality of your measurements, data.
- Quality of the write-up (completeness, polish, readability, organization, and documentation of your procedure).
- Inclusion of sample calculations and error analysis (where appropriate -- this may differ from one project to another).

Your class presentation will be marked on these criteria:

- Description of the necessary background (explain the background physics and experimental setup).

- Concise summary of results and appropriate "style" (Is it best to use the blackboard or overhead projector with a mini-lecture? Run a sample experiment in real time in front of the class? Skit format?)
- Energy, enthusiasm, class involvement, originality.
- Confidence of delivery (Can everyone hear you? Did you practice beforehand? Are both you and your partner participating equally?)

Timing and selection of material (stay within time limits and pick what you want to say...)

McMaster Policy on Academic Integrity:

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences—e.g., the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty, please refer to the Academic Integrity Policy, located at: <http://www.mcmaster.ca/academicintegrity>

The following illustrates only three forms of academic dishonesty: 1) Plagiarism—e.g., the submission of work that is not one's own or for which other credit has been obtained. 2) Improper collaboration in group work. 3) Copying or using unauthorized aids in tests and examinations.

McMaster Student Absence Form (MSAF):

In the event of an absence, students should review and follow the Academic Regulations in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work." Please consult the MSAF statement on our website (<https://artsci.mcmaster.ca/forms-requests/>) and direct any questions or concerns to Shelley Anderson or Rebecca Bishop in the Arts & Science Program Office as appropriate.

Academic Accommodation of Students with Disabilities:

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or email sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

Email Contact and Student Responsibility:

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of students to check **their McMaster email** and course websites weekly during the term and to note any changes. I will make announcements in class and by using the course e-mail distribution list.