

Arts & Science 2D06: Physics – Course Outline
Term 3 - 2014/15

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

E-mail: chenal@mcmaster.ca **Office:** ABB-260A

Office Hours: TBD after student survey during first class

Class Times: Mondays, Wednesdays, Thursdays, 1:30 – 2:20, BSB 137

Tutorial Times: Mondays, 11:30am, ABB 166
Fridays, 8:30am, BSB B154

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.

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 must decide for themselves whether or not to seek and provide documentation to support requests for special consideration. This applies to any missed work, absences planned or unplanned, or any rescheduling of coursework. 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 describes 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 – 2014/15 – Estimated Weekly Schedule – Term 1

Week	Beginning	Topic
1	Sep 1	One dimensional kinematics
2	Sep 8	One and Two dimensional kinematics
3	Sep 15	Forces, Newton's Laws
4	Sep 22	Newton's laws of motion
5	Sep 29	Work, kinetic energy
6	Oct 6	Potential energy, energy conservation
7	Oct 13	Energy conservation
8	Oct 20	Momentum
9	Oct 27	Momentum conservation; MID-TERM RECESS
10	Nov 3	Momentum conservation, special relativity
11	Nov 10	Special relativity
12	Nov 17	Special relativity
13	Nov 24	Project presentations

Arts & Science 2D06 – 2014/15 – Estimated Weekly Schedule – Term 2

Week	Beginning	Topic
1	Jan 5	Fluid mechanics: hydrostatics
2	Jan 12	Fluid mechanics: fluids in motion
3	Jan 19	Simple harmonic motion
4	Jan 26	Wave motion and wave phenomena
5	Feb 2	Interference phenomena in light
6	Feb 9	Interference of light
7	Feb 16	MID-TERM RECESS
8	Feb 23	Historical quantum mechanics
9	Mar 2	Quantum mechanics and the atom
10	Mar 9	Uncertainty principle and other quantum ideas
11	Mar 16	Finish quantum mechanics
12	Mar 23	General relativity
13	Mar 30	General relativity + Project presentations
14	Apr 6	Project presentations

Arts and Science 2D06 - 2014/15

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 19**, before 5 PM in

Alan's office. If you hand in your write-up on November 18 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after November 19 will have a 2-mark penalty applied.

The due date for your written report in Term II is **Wednesday, March 18**, before 5 PM. If you hand in your write-up on March 17 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after March 18 will have a 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...)

Academic Integrity Statement

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.

MSAF Statement

McMaster Student Absence Form (MSAF):

This is an on-line, self-reporting tool for students to report absences due to minor medical situations that last up to 5 days and to request accommodation for any missed academic work that is worth less than 30% of the final grade. Please note that this tool cannot be used during any final examination period. It is the prerogative of the instructor to determine the appropriate relief for missed term work. You may submit a maximum of one request per term. The form should be filled out immediately when you are about to return to class after your absence. It is your responsibility to follow up with your instructor immediately (within two working days) about the nature of the accommodation.

If you are absent for more than 5 days, have missed academic work worth 30% or more, or exceed one request per term, you must see Shelley Anderson or Rebecca Bishop in the Arts & Science Program office (C-105). You will be required to provide supporting documentation.

Email Contact and Student Responsibility

Please Note:

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.

Academic Accommodation of Students with Disabilities Statement

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.