Arts & Science 2D06: Physics – Course Outline
Term 3 - 2015/16

Instructor: Prof. Christine Wilson, Department of Physics and Astronomy
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Office Hours: Monday 1:00pm-2:00pm, Thursday 2:00pm-3:00pm,

Class Times: Tuesdays, Wednesdays, Fridays, 12:30 – 1:20, BSB 137

Tutorial Times: Fridays, 10:30am, GS101
Fridays, 2:30pm, GS101

TAs: Ashley Bemis, bemisa@mcmaster.ca, ABB-245C, office hour Tues 2pm-3pm, ABB-245C
Jared Enns, ennsjj@mcmaster.ca, ABB-327B, office hour Wed 2pm-3pm, ABB-327B

Required material:

- **Textbook:** Knight, Physics for Scientists and Engineers: a Strategic Approach (with Modern Physics), 3rd Edition

- **Calculator:** McMaster standard calculator (CASIO fx991) – to be used for all quizzes and exams – available in the campus bookstore.

- **iClicker:** to be used for in-class quizzes – available in the campus bookstore

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

The course **website** on Avenue to Learn will be used throughout the term for posting schedules, information, suggested problem sets from the textbook, last year's quizzes, historical links, etc. Plan to 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 may be required reading and will be mentioned at appropriate times during the course.

Marking scheme:

24% April exam
24% December exam
16% Midterms (four tests, two per term, written during normal class time)
21% Laboratory work (2 major projects, one each term, and one class presentation)
10% Quick quizzes (5-10 minutes, 7-8 per term, lowest quiz mark dropped each term)
5% Participation (e.g., project presentation days, in-class discussions, iClicker questions)

The December and April exams and all laboratory work must be completed to pass the course. Students should keep a copy of anything handed in for marking (such as a project report).

Missed Midterms and Quick Quizzes

There will be no re-weighting of marks to accommodate missed work. (1) Students who submit MSAFs for midterms will be required to write a make-up midterm, which will be different from the missed one but of comparable level of difficulty and same coverage of material. For a given midterm, one make-up test session for all students will be held in C-105 or in ABB. (2) There will be no makeup for any missed quizzes beyond the normal dropping of the lowest quiz mark in each semester. (3) There will be no makeup for missed iClicker questions. iClicker questions will be scored based on participation and correct answers. Full marks for iClickers will be awarded to students earning 80% or higher on the iClicker questions; marks for students earning less than 80% will be scaled i.e. 72% earned = 72/80 = 90% awarded for iClickers.

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 develop a conceptual understanding of these physical laws and principles and to be able to apply this conceptual understanding to simplified situations in the real world
• 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

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 – 2015/16 – Estimated Weekly Schedule – Term 1

Week	Beginning	Topic
1	Sep 7	One dimensional kinematics
2	Sep 14	Forces, Newton's Laws
3	Sep 21	Newton's laws of motion
4	Sep 28	Two dimensional kinematics
5	Oct 5	Work, kinetic energy MIDTERM #1: WEDNESDAY, OCT 7
6	Oct 12	MID-TERM RECESS
7	Oct 19	Potential energy, energy conservation
8	Oct 26	Energy conservation; Momentum
9	Nov 2	Momentum conservation MIDTERM #2: WEDNESDAY, NOV 4
10	Nov 9	Momentum conservation; special relativity
11	Nov 16	Special relativity
12	Nov 23	Special relativity; project presentations PROJECT REPORTS DUE NOV 25
13	Nov 30	Project presentations (including Dec 8)

Arts & Science 2D06 – 2015/16 – Estimated Weekly Schedule – Term 2

Week	Beginning	Topic
1	Jan 4	Fluid mechanics: hydrostatics
2	Jan 11	Fluid mechanics: fluids in motion
3	Jan 18	Simple harmonic motion
4	Jan 25	Wave motion and wave phenomena
5	Feb 1	Interference phenomena in light MIDTERM #3: WEDNESDAY, FEB 3
6	Feb 8	Interference of light
7	Feb 15	MID-TERM RECESS
8	Feb 22	Historical quantum mechanics
9	Feb 29	Quantum mechanics and the atom MIDTERM #4: WEDNESDAY, MAR 2
10	Mar 7	Uncertainty principle and other quantum ideas
11	Mar 14	General relativity PROJECT REPORTS DUE MAR 16
12	Mar 21	General relativity
13	Mar 28	General relativity; Project presentations
14	Apr 4	Project presentations

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.

In this course we will use a web-based service (Turnitin.com) to check for plagiarism on content submitted on Avenue to Learn. Students will be expected to submit their work electronically so that it can be checked for academic dishonesty. Students who do not wish to submit their work via Avenue to Learn (to be checked by Turnitin.com) must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to www.mcmaster.ca/academicintegrity

McMaster Student Absence Form (MSAF):
In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work." Please also see the MSAF statement on our website (http://artsci.mcmaster.ca/) and direct any questions or concerns to Shelley Anderson or Rebecca Bishop in the Arts & Science Program Office as appropriate.

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. Announcements will be made in class and by using the course email distribution list.

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.

Sustainable Written Work Submission Guidelines
The written work submission guidelines have been chosen to support the more sustainable use of paper, energy, and toner, and meet the Gold standard of the Office of Sustainability www.mcmaster.ca/sustaiinability. All written work should be submitted in the following format: double-sided printing; no title page; sans-serif font. Please use font size no smaller than 11pt for the body of the text.

Arts and Science 2D06 - 2015/16
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 from which you can choose. 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 25**, before 5 PM Christine's office. If you hand in your write-up on November 24 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after November 25 will have a 2-mark penalty applied.

The due date for your written report in Term II is **Wednesday**, **March 16**, before 5 PM. If you hand in your write-up on March 15 or before, you will get a 1-mark bonus (out of a total mark of 20). Reports handed in after March 16 will have a 2-mark penalty applied.

<u>Evaluation of your Write-up and Presentation:</u>

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...)