Physics 2E3 Course Outline, January 2015

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Text: John R. Taylor, *Classical Mechanics*, University Science Books

The text for the course is readable and reasonably complete. Additional reading can be found by browsing through the QA805-QA807 section in the library. Check the preface and table of contents first, as elementary and advanced texts are randomly intermingled. In other years we have used, for second-year courses, *Introduction to Classical Mechanics* by Atam Arya, and *Analytical Mechanics* by Fowles (later Fowles and Cassiday). Somewhat more advanced texts include *Classical Dynamics* by Marion and Thornton and *Classical Mechanics* by Chow. Both present the same material at about a third-year level. *Newtonian Dynamics* by Ralph Baierlein is concise and pleasant to read, but also a little more advanced than Taylor. A classic graduate-level text is *Classical Mechanics* by Goldstein.

A "calculus-based" first-year Physics text (*e.g.,* Serway and Jewett, Knight, Halliday and Resnick, and others) will be helpful sometimes, particularly if it has been a few years since you took first-year physics. Try the QC21-QC23 section of the library. You may want to review the math you learned in first year (differential and integral calculus, complex numbers), so pull out your old math text, or borrow an older edition from the library.

Marks:
Exam, 50%
Two midterm tests, 35%
Assignments, 15%
Marks will be combined using a 100-point scale. We reserve the right to alter the weightings given above, provided it does not decrease a student's grade.

The final exam in April will be three hours long. There will be two midterm tests; dates and times to be determined. Problem sets will be assigned weekly, skipping a week at each midterm test; eight or nine assignments altogether. Students are expected to attend all lectures, take notes, and participate in discussions.

Only the *Casio fx-991* calculator may be used during tests and the final examination.

Academic Ethics and Collaboration: Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, *e.g.* a 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 the responsibility of the student to understand just what does constitute academic dishonesty and to be aware of the penalties. Please refer to the Academic Integrity Policy, posted at **http://www.mcmaster.ca/academicintegrity/** Students are expected to complete their assignments independently. You are encouraged to discuss assignment problems with other students, and to share ideas about *general approaches* to the solution. However, each student should work out the final details independently, and **write up the final answer without referring to any written solution or rough work from any other source.** This particularly forbids "working on the assignment together" but handing in two or more substantially identical solutions; or copying a solution found on the web or elsewhere and presenting it as your own.

The course:

Physics 2E3 introduces the student to the analytical methods used in Newtonian mechanics. A few particular problems (*e.g.,* the 1-D oscillator, Kepler orbits) will be treated in some detail, but the emphasis is on general methods and principles. Conservations laws figure prominently. Assignment and exam questions may ask the student to *derive* a solution or *prove* a result from basic principles, using the same general approach presented in class. The objective is to learn the *methods* of classical mechanics rather than simply the results.

Newtonian mechanics describes the world using second-order differential equations. Methods of solution are developed as we go, without assuming a prior course in differential equations. The student is assumed to be familiar with complex numbers, vector algebra (dot products, cross products) and differential and integral calculus. We make some use of integral calculus in two and three dimensions, in rectangular and polar coordinates. We will occasionally use vector calculus (div, grad, curl, *etc.*) in an incidental way.

The following list of topics, and particularly the implied schedule, should be regarded as approximate. Some sections of the chapters listed will be omitted:

1. (Text chapter 1) Newton's Laws, coordinate systems (2 or 3 lectures)
2. (Text chapter 2) Drag forces, Projectiles (3 lectures)
    - section 2.6 (complex exponentials) will be deferred until later
    - we will likely skip section 2.7
3. (Text chapter 3) Momentum and angular momentum (3 or 4 lectures)
    - Some material from Chapter 10, sections 10.1 and 10.2, will be included here.
4. (Text chapter 4) Energy (3 or 4 lectures)
    - some sections (*e.g.* 4.4, 4.8) will be covered superficially
5. (Text chapter 5) Oscillations (4 or 5 lectures)
6. (Text chapter 7) Lagrange's Equations (5 lectures)
    - skip chapter 6;
    - Skip section 7.4, and 7.9, 7.10
    - include Chapter 13, sections 13.1 to 13.4
7. (Text chapter 8) 2-body central force problem (3 or 4 lectures)
    - derivation of Kepler's Laws
    - energy in bound and unbound systems
8. (Text chapter 9) Accelerated reference frames (3 or 4 lectures)
    - fictitious forces; rotating coordinates
    - static effects of the earth's rotation
    - dynamic effects: Coriolis forces, examples; Foucault pendulum?
9. Other topics (*e.g.*, Rigid-body rotation in 3-D, text chapter 10), a few lectures, if time permits.