Phys 2022 **Classical Physics** **Fall 2016**

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Prerequisites: Calc II (Math 1297); General Physics II (Phys 2015) may be taken concurrently.

Text: *Vibrations and Waves* by French; you should also have access to a General Physics text such as *University Physics* by Young and Freedman. There will some use of numerical methods; if you do not have a textbook on Matlab (e.g. from CS1411), a *recommended* short introduction to Matlab, *Getting Started with Matlab* by Pratap is available in the Bookstore.

Catalog description: Survey of various topics in classical physics: vector angular momentum, AC circuits, oscillatory motion, waves, physical optics.

Course content: We will begin with a review and extension of selected concepts covered in Phys 2013. The emphasis will be on making more substantial use of techniques from calculus, vector properties, and numerical approaches. We will then undertake a systematic study of the physics and mathematics of oscillatory motion ranging from masses on springs through AC electrical circuits onto waves in various media. This will include extensive practice with complex numbers and the use and solution of differential equations in describing oscillatory systems.

Grading: Course grades will be based on these contributions and associated weights.

- Homework and Quizzes 30%
- Tests (at least two) 40%
- Final exam 30% (Tuesday Dec. 13, 10 am.)

The expected grading scale is: $> 88\% \Rightarrow$A-,A; $> 76\% \Rightarrow$B-,B,B+; $> 64\% \Rightarrow$C-,C,C+; $> 55\% \Rightarrow$D,D+.

Homework: Reading and problems will be assigned regularly. Little will be learned here without extensive practice through working problems. Satisfactory homework solutions must include complete development of mathematical aspects and brief English explanations of the reasoning that guides your method of solution. The necessary habits and expected features of homework sets are described below. Late homework is subject to a 50% penalty, and once a problem solution is posted or presented in class, late solutions will not be accepted.

Discussion of homework problems with classmates is permitted and encouraged. Use of solution manuals or comparable resources is not permitted. All work turned in must be your own, *i.e.*, you are able to present you solution and explain it to the instructor and class.

Aside from problems requiring numerical computations, problems shall be solved the old-fashioned way, using hand-crafted mathematics, not computer-based symbolic manipulations.

Use of computer algebra packages such as Mathematica or Maple or comparably trained calculators is not acceptable in working homework problems. Opportunities for practice with numerical methods, including the use of Matlab, will be presented.

If there are aspects of this course that result in barriers to your inclusion or your ability to meet course requirements, please notify the instructor as soon as possible. Contact the Office of Disability Resources (KSC 258) to discuss and arrange reasonable accommodations. Please call 218-726-6130 or visit the DR website at www.d.umn.edu/access for more information.

University Policies: Information about various applicable University policies should be reviewed at http://www.d.umn.edu/vcaa/SyllabusStatements.html.

Details of the course procedures and policies described here may be amended and posted as deemed appropriate by the instructor.

Homework Requirements

> There is a peculiar synergy between mathematics and ordinary language. . . The two modes of discourse (words and symbols) stimulate and reinforce one another. Without adequate verbal support, the formulas and diagrams tend to lose their meaning; without formulas and diagrams, the words and phrases refuse to take on new meanings.
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> — David Layzer
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> [Quoted in Am. J. Phys. **71**, 1223 (2003).]

Homework must be presented in a format so another person can understand the logic and the individual steps of the solution. The solution must be presented in a systematic, step-by-step fashion, with brief explanations of what is being done and the reasoning involved. (Yes, that means using words and learning to write/speak physics!) The presentation must be organized. You may find it necessary to work problems out initially on scratch paper, then re-copy them so the presentation follows a logical flow easily understood by others, with the wrong turns and preliminary mistakes removed.

- **Make the question part of your answer.** Your solution should make clear what the problem asks. It shouldn't be necessary to consult the problem statement to figure out what problem is being solved.

- **Include diagrams that illustrate the system under consideration.** Visualizing the problem whenever possible is a useful habit. Use the diagram to relate important variables or parameters in the problem to your calculations. Defining quantities or symbols used in the mathematics as part of your figure is efficient. Make your drawings large and clear.

- **Start with basic principles.** You will learn more and remember the basic formulas if you solve problems by doing a few lines of algebra re-deriving a result, rather than by hunting through the text looking for a specialized formula you think fits the situation at hand.

- **Write complete equations.** Equations have a left-hand side, an = sign, and a right-hand side; they are not a string of mathematical phrases randomly conjoined by = signs. Work *down* the page, presenting one step of a calculation at a time. Don't present several steps in a horizontal sequence, or try to combine several algebraic manipulations into a single line. Neither $\longrightarrow$ nor $\Longrightarrow$ is a substitute for =. There's no shame in writing out a series of simple steps in detail to ensure you get the correct result. Hasty work is error-prone.

- **Use standard and correct notation.** Vector quantities need arrows: $\vec{r}$, $\vec{F}$, $\vec{v}$, $\vec{E}$, $\vec{B}$. Learn and use standard notation. Write so the reader can tell your lower case m from your uppercase M. Get familiar with and practice the Greek alphabet. For example, density is often denoted by the Greek letter ρ (rho); p is not a suitable substitute for it. Your ρ's shouldn't look like p's. Deliberate practice helps.

- **Work problems symbolically as far as possible.** Plugging in numbers should be done after all the algebraic manipulations.

- **Include units with all numerical values.** Show explicitly how the units reduce to the final result as part of the step-by-step presentation. Do not add units at the end of a problem as an afterthought.
- **Use lots of paper.** Do not attempt to crowd several problem solutions onto one page. If you manage to do so, you've ignored most of the items above. Start a problem on a fresh page. Do not erase large tracts of errant calculations and write over the used real estate. Big mistakes call for a new sheet of paper.
- **Start early.** Don't expect to solve problems adequately in the last hour before class. You can't ask questions in time to get help when you wait to the last minute. You should not be surprised to find that solving a problem may require an initial attempt, leaving it for a while to let it mature in your brain, and then return to it again for another attempt.