Description

What's the goal?

The main purpose of this 2-credit course is to gently guide you from high-school level algebra to the more advanced maths that is encountered in the *Foundations of Physics* sequence. This includes vectors, calculus, and a combination of the two. We'll take a physics-oriented approach to these topics.

Physics-oriented maths means that we're less interested in general theorems than in concrete applications that are relevant in particular to PHYS 252. In physics, calculus is a means to an end; in mathematics, calculus is an end in its own right. Therefore, this course cannot replace a full-year calculus sequence, but it will make you more comfortable with the mathematical language on which all your physics courses rely.

With its focus on physics-relevant topics, the course will also help deepen your understanding of concepts that you may have had trouble with in PHYS 251.

Who is it for?

With this goal in mind, you'll benefit most from this course if you *do not have any background* in pre-calc or calculus. I won't judge you on the basis of your prior maths knowledge. We especially welcome students who, for any reason, haven't had the opportunity to take advanced maths courses in high school. The same applies if you're just starting out as a physics student but simply haven't practiced high-school maths for a while.

This course can also be a useful supplement to the main *Foundations of Physics* sequence if you're looking for some extra opportunities to review what you learned there. However, I do not assume any specific knowledge of the material from PHYS 251. Instead, I'll reacquaint you with the physics concepts as needed.

Course materials

You'll need a scientific calculator to be used in homework and in class. A web-based scientific calculator can be found [at this link](https://pages.uoregon.edu/jenscls/physicsCalculator.html).

Readings and worksheets will be provided for free.

You'll get the most out of this course if you also have the textbook that's currently being used in PHYS 251, 252 (Knight). But this is optional. As a physicist, you should collect some "reference" textbooks that you can revisit later to refresh your memory.

I also strongly recommend downloading the following app:

[Algodo](http://www.algodoo.com/download/)

This is optional.

Algodo can help build your intuition for the laws of physics, and it even helps solve actual physics problems sometimes.

I myself use it a lot in my lectures.

Schedule
In your introductory physics course, you will often encounter formulas and laws that seem to fall from the sky. When that happens, your instructor will probably tell you "trust me, it works - but you need calculus to prove this." For example, do you know where the formula for the centripetal acceleration in circular motion comes from? In PHYS 251, 252, you're expected to be able to apply such formulas, but you're not expected to know all of their secrets yet.

This can be frustrating if you believe (as the textbooks tell you) that Newton's Laws explain everything in mechanics. Where is Newton hiding in the formula for the centripetal acceleration? By the end of this course, I'm hoping you'll have the tools to be able to answer such questions. This will be important especially as you move on to PHYS 351. The tools we'll be talking about are selected so that they're also relevant concurrently with the introductory courses you're taking this term.

The following is a tentative plan, and it may change based on your feedback and questions.

- **Lecture 1:** Analyzing data, weighted averages (relation to the Law of Levers)
- **Lecture 2:** Wildcard week: powers, exponents and units in physics (topics depend on feedback)
- **Lecture 3:** Newton's First Law, Motion and Center of Mass (make connections to PHYS 251, graph functions...)
- **Lecture 4:** Graphical and symbolic methods for vectors (vector addition, scalar multiplication, angles...)
- **Lecture 5:** Sine, cosine and their relationship to vectors (scalar and vector products) (includes inverse trig functions; depends on previous lecture)
- **Lecture 6:** Exponential function, natural logarithm and Euler's number (graphically inverting a function, relation to other bases)
- **Lecture 7:** Approximating a function; limits, infinity and infinitesimals (Zeno's paradox, are instants real? Free fall as an example.)
- **Lecture 8:** Derivatives and rules of differentiation (Velocity, acceleration and potential energy)
- **Lecture 9:** Series and integrals (density, center of mass, moment of inertia) (possibly other applications related to PHYS 252)
- **Lecture 10:** Higher derivatives and differential equations (Newton's Second Law, waves) (alternatively: revisit derivatives, discuss gradient)

**Grading**

The purpose of the course is to level the playing field with a view toward your other physics courses, so the grades in PHYS 299 are not intended to be punitive in any way. They are merely a way for me to incentivize your participation. If I see that you're making an effort, you will get a passing grade.

The grade reflects what I consider to be a valid effort:

Grades for the course will be based on

- 40%: weekly attendance (either attend class or attend an office hour, or both)
- 40%: worksheets that you may complete in class or at home.
- 20%: conceptual quizzes held online through Canvas (based on reading material)

There will be no midterms or final exam.

You're allowed to work together or use external resources for all assignments.

Worksheets will be handed out in class or posted on Canvas. You're expected to complete them in your own words, even if you collaborated with others. There will be conceptual and quantitative questions on the worksheets.

The score for all Canvas quizzes is based on the number of correct answers. You don't get points for incorrect answers, but you don't get penalized for them either.

**Late policy for all Canvas quizzes:**

For any late submission, you get a score that's reduced to 80% (i.e. 20% subtraction). This is done automatically in Canvas. I can override this on a case-by-case basis if you have a valid excuse.

**Late policy for worksheets:**

Here we'll use an incentive system:

You'll automatically get 50% for each worksheet that you complete by the deadline. The remaining 50% will be calculated based on the percentage you answered correctly.

So if you submit a worksheet on time but got only 50% right, then your total score will be
50% + 0.5 * 50% = 75%

But if you miss the deadline and get 50% right, your score will be

0.5 * 50% = 25%

This policy is intended to encourage you to keep up with the coursework, so that the tasks don't pile up on you. This is important for the course, because I want everybody to be on the same page.

We’ll spend at least part of each class going through the worksheets together.

**Pass/fail grading option:** a passing grade requires the equivalent of a C grade on all coursework.

**Grading scale:** You are guaranteed at least the grade listed below based on your final average; you are not competing with others in the class for your grade.

- ≥97: A+
- ≥93: A
- ≥90: A−
- ≥87: B+
- ≥83: B
- ≥77: C+
- ≥73: C
- ≥67: D+
- ≥63: D
- ≥60: D−
- <60: F

For example, if you have perfect attendance and submitted all assignments, but got all your worksheets wrong, you'll still get an A− (don't worry, you won't get all worksheets wrong).

**Office hours**

**The course has a TA:** Aria Radick

Together, we'll arrange for three office hours outside of class.

Times and places will be posted after the first class meeting at the beginning of the term.

You’re encouraged to use these office hours to get help with any of the assignments: Canvas quiz questions and worksheets.

**Academic Honesty**

Students are expected to abide by university policies on academic honesty, avoiding plagiarism, fabrication, cheating, and academic misconduct. The Student Conduct Code ([https://dos.uoregon.edu/conduct](https://dos.uoregon.edu/conduct)) provides definitions of these terms and explanations of the university policy on the subject. Academic dishonesty will be dealt with severely, as it is disrespectful to your fellow students and your instructor, as well as being against both university regulations and state laws.

**Other resources**

Lastly, the University’s Tutoring and Academic Engagement Center may also be able to assist UO students. I'd suggest contacting them only after touching base with me first. For more information see [https://engage.uoregon.edu](https://engage.uoregon.edu)

**Students with disabilities**

If there are aspects of the instruction or course design that result in barriers to your inclusion, please notify Prof. Noeckel (noeckel@uoregon.edu) as soon as possible. You are also welcome to contact Disability Services in 164 Oregon Hall, 346-1155.

**Course Summary:**

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<th>Details</th>
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