General Physics with Calculus (PH 212, Summer 2019, 4 credits)

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Course Website URL: khadley.com
Prerequisites: MTH 252 and PH 211
Corequisite: MTH 254
Text: *Physics for Scientists and Engineers*, 4th edition, Knight
Additional Items: Access to MasteringPhysics which comes bundled with the textbook (including an *optional* workbook for no cost) at the OSU bookstore, and a ResponseCard NXT hand-held communication device (Turning Point clicker). The lab manual is posted on Canvas.

What is Physics? Physics is the study of nature. It is a *living* discipline, not a collection of facts. It is the science of daily existence. One has direct experience with the nature of forces, how things respond to those forces, the conservation of mass, energy, momentum, and some aspects of gravity. The formal study of physics should guide and clarify one's understanding to build a consistent basis of fundamentals that allows one to build models for describing the physical behavior of unfamiliar or complex systems. Physics is about reasoning, making connections, and understanding what will happen in a situation, and why it happens.

In order to do physics in a genuine sense, it is necessary to be able to apply the skills used within the discipline to new situations. When dealing with new situations, mathematical models are used to describe them. Applying these models often requires simplifications or assumptions about the physical situation. It is necessary to become proficient with the use of models, their applicability, when they are not appropriate and why, and to be able to analyze situations multiple ways. One goal is to develop a set of skills and tools that one can use to analyze any basic system, and to understand what the next step would need to be to address a more complex aspect of that system.

It is important to know terminology, and useful to know facts such as historic progressions, but these things can be obtained from a multitude of sources. There are many textbooks and online resources for gathering facts. More importantly, in today's world there is more information available than any one has time to parse, so the whole nature of coursework must change with the times.

We will use historical experiments and scientific development, contexts from other disciplines, and modern experiments at the frontiers of our knowledge to develop the ideas in the learning outcomes and for problem solving whenever possible. The learning outcomes and critical thinking will be developed through in class demonstrations, voting questions, peer-to-peer discussions, full-class discussions, in-lecture group work and lab work. They will be *formatively* assessed through voting questions and lab work, and *summatively* assessed during exams.

Baccalaureate Core Student Learning Outcomes: This course fulfills the Baccalaureate Core requirement for the **Physical Science** category:

1) Recognize and apply concepts and theories of basic physical or biological sciences;
2) Apply scientific methodology and demonstrate the ability to draw conclusions based on observation, analysis, and synthesis;
3) Demonstrate connections with other subject areas.

See the tables at the end of this document for detailed description of assessment of each outcome and the connection between the baccalaureate core student learning outcomes and the course-specific learning outcomes.

Course-Specific Learning Outcomes: By the end of this course, you will be able to:

1. Understand how to represent and analyze motion for solids, oscillations and waves;
2. Apply fundamental physics principles to analyze the behavior of physical situations under certain conditions, and to understand when to apply these laws, and how to extend these general situations to specific applications such as how microscopes work;
3. Make observations of physical behavior and find explanations that are consistent with the observations, apply these explanations and the established laws to make predictions about outcomes of experiments, and test the explanations and laws through experimentation ;
4. Represent information in multiple ways (diagrams, graphs, words, equations. etc.), and move from one representation to another, use these representations to set up problem solutions, predict the behaviors of systems, and to check the solutions to problems;
5. Use critical thinking skills as described below.

   Critical thinking is a fundamental part of science and at the heart of physics. In many ways, physics is the discipline of modeling and problem solving. In this course, you will look at new situations and make assumptions about them which allow you to make appropriate simplifications to apply physical models. Critical thinking is being able to:

   - analyze an open-ended, new physical system
   - consider what assumptions and simplifications can be made
   - breakdown the situation into manageable pieces
   - apply concepts to analyze each piece and combine them into a solution
   - evaluate if the solution makes sense

What to Expect from Lecture: Lecture meets for one hour, four times per week. The purpose of lecture will be developing conceptual understanding, working on representing phenomenon, practicing problem solving, and building understanding though observations and explanations of phenomena. Lecture is interactive. There will be times in lecture that you are strongly encouraged to talk with other students near you. However, it is disruptive if you talk while the instructor is talking. Questions, comments, and interruptions are welcome, but please raise your hand.

What to Expect from Lab: The lab is the appropriate place for you to apply the tools and skills to explore more complex situations. The labs will get increasingly more open-ended, so eventually you will be able to do authentic physics modeling of real situations. Required lab write-ups will be completed during the lab period. The lab manual is posted on Canvas.

Textbook: Most students find it helpful to read the textbook before lecture to help understand what occurs during lecture and ask productive questions. Most students also find it helpful to read the textbook after lecture to solidify what they learned during lecture. Think about the questions asked in the book as you go along and make note of what doesn't make sense to you so you can ask about it later. Most importantly, *don't fall behind* because most concepts build on those encountered earlier.

Communication: Communication will be through announcements given in lecture and posted on Canvas, and via email. You are expected to check these daily.

Exams: There will be three midterm exams (80 points each) and one final exam (100 points). The midterm exams are held at the same time and location as the lecture. All exams are closed book and comprehensive,

and will include material from readings, labs, lecture, and/or homework. The exams will consist of conceptual questions and write-out problems, including all aspects of problem-solving required for homework. A formula sheet will be provided with each exam. Formula sheets are posted on Canvas.

Bring a photo ID to each exam. **Any official exam conflict must be discussed and arrangements made with the instructor *before* the exam.** Unexcused absence will result in a zero for the exam, including the final exam. If you believe that an error was made in the grading of an exam question, then bring your complete exam to the instructor *within fifteen days* after the exams have been returned. Never make any alterations or additions to the exam itself.

Lab: Lab meets for three hours once per week, most weeks of the term. 100 points are earned for attending and conducting all of the labs, and obtaining an *average* of at least two-thirds of the possible points for the lab reports over the course of the term. Each group will write one lab report *during* each lab. **You must pass lab in order to pass the course.** There is opportunity to make-up one or two labs during the last week of the term. Any lab scheduling issues should be addressed directly with the lab TAs.

Recitation, PH 222: Recitation is not required, but strongly recommended. It consists of weekly group problem solving sessions. Recitations are taught by experienced TAs who can address individual problems and provide guidance in small group sessions.
Honors Recitation, PH 222H: This course is not offered during the summer.

Formative Assessment Points: *Formative assessment is a self-reflective process that intends to promote student learning*, and as such occurs during the learning process, before graded exams. The Turning Point system will be used for formative assessment during lecture. One can earn up to 50 points for questions answered during lecture using the clickers. There will be three excused absences for illness, school functions or any other reason. If you have extenuating circumstances such as serious illness or injury, please contact me right away. Because formative assessment is a learning tool, you will get full points for participating in all of the questions for that day *regardless of whether you choose the most correct answer.* The use of multiple clickers is not allowed.

Homework: You can earn up to 60 points for homework: 30 points for online homework and 30 points for written homework. Online homework will be assigned on MasteringPhysics. Also, hand-written problems will be assigned to evaluate aspects of the solutions that cannot be graded by MasteringPhysics. Written homework should be labeled with *your name and assignment number clearly printed at the top right-hand corner.* The lowest homework grade for online homework and the lowest score for written homework will be dropped when calculating the total homework score, and each assignment will carry the same weight.

Grading Breakdown and Final Grades:

- Three midterms (80 points each) and the final exam (100 points)
- 100 points for lab. Students who opt out of are automatically awarded these points. Failing the lab results in failing the course. You must pass the lab in order to pass the course.
- Homework: 60 points
- Formative Assessment: 50 points
- Pre-lecture Assignments: 50 points
- Total: 600 points

Example Grade calculation: Student X earned 68% on the first midterm, 75% on the second midterm, 70% on the third midterm, 70% on the final exam, 100 points for passing the lab. 90% on online homework, 85% on written homework points, 90% of clicker points and 75% of pre-lecture points. The final grade for Student X is:

$$[(.68)80 + (.75)80 + (.70)80 + (.70)100 + 100 + (.90)30 + (.85)30 + (.90)50 + (.75)50]/600 = 79\%$$

Grade Scale: The grade scale is fixed. There is no curve in this course.

90 - 100% = A	85 - 89% = A-	82 - 84% = B+	78 - 81% = B
75 - 77% = B-	72 - 74% = C+	68 - 71% = C	65 - 67% = C-
62 - 64% = D+	58 - 61% = D	55 - 57% = D-	0 - 54% = F

Email Policy and Canvas Discussion Forums: There are forums to use for out-of-class discussion on Canvas. Please post any course policy, reading, content, or homework questions on Canvas in these forums. The instructor will respond to the forums daily during weekdays so that everyone can have access to the answers, and you are encouraged to post help for each other as well. If you have a question, then it is likely to be helpful to your classmates as well. Posts from classmates addressing content issues are also welcome. You're encouraged to help each other. Use these forums instead of emailing me directly for homework help unless you have a personal question or concern that will not be appropriate or helpful for everyone.

Calculators: You will need a calculator for lecture, studio, recitation, lab, and exams. **Graphing calculators, those with a solver feature and/or graphing window may not be used for exams.** You should have a scientific calculator that has trigonometric, logarithmic, and exponential functions. If you want to know whether or not your calculator is acceptable or not for exams, then consult the instructor well before the first exam.

TA Office Hours: The TAs will hold office hours in Wngr 334. A schedule will be posted outside Wngr 334. TA office hours start in the middle of the first week of the term.

Students with Disabilities: Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Academic Integrity: You will be expected to conduct yourself in a professional manner. Academic dishonesty such as plagiarism and cheating will not be tolerated. Therefore, students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

* cheating - use or attempted use of unauthorized materials, information or study aids,
* fabrication - falsification or invention of any information,
* assisting - helping another commit an act of academic dishonesty,
* tampering - altering or interfering with evaluation instruments and documents, or
* plagiarism - representing the words or ideas of another person as one's own.
* using multiple ResponseCard NXT units during a single lecture period

For more information about academic integrity and the University's policies and procedures in this area, please refer to the Student Conduct web site.

Week	Date	Chapter	Sections Covered	Homework	Lab
1	M 6/24	4	4.4-6		Lab 1: Rotational Motion
	T 6/25	4			
	W 6/26	8	8.1-5		
	R 6/27	8			
2	M 7/1	8		Hw 1 due (Ch4,8)	No Lab
	T 7/2	12	12.1-12		
	W 7/3	12			
	R 7/4	No school			
3	M 7/8	12			Lab 2: Rotational Dynamics
	T 7/9	12		Hw 2 due (Ch12)	
	W 7/10	Mid 1	Ch 4, 8, 12		
	R 7/11	15	15.1-8		
4	M 7/15	15			Lab 3: Oscillations
	T 7/16	15		Hw 3 due (Ch 15)	
	W 7/17	16	16.1-9		
	R 7/18	16			
5	M 7/22	16		Hw 4 due (Ch 16)	Lab 4: Standing Waves
	T 7/23	17	17.1-8		
	W 7/24	17			
	R 7/25	17		Hw 5 due (Ch 17)	
6	M 7/29	Mid 2	Ch 15, 16, 17		Lab 5: Interference
	T 7/30	33	33.1-4		
	W 7/31	33			
	R 8/1	33			
7	M 8/5	34	34.1-6	Hw 6 due (Ch 33)	Lab 6: Refraction
	T 8/6	34			
	W 8/7	34			
	R 8/8	34		Hw 7 due (Ch 34)	
8	M 8/12	Mid3	Ch 33, 34		Make-up Labs
	T 8/13	13	13.1-6		
	W 8/14	13		Hw 8 due (Ch 13)	
	R 8/15	Final exam	All Chapters		

All dates are tentative and subject to change.

CLO	Subject	Activities	Assessment
Category Learning Outcome #1	How does the course align with or meet this specific outcome?	What assignments, class activities, and discussions are used to address this outcome?	How is student achievement of this outcome formally measured?
Recognize and apply concepts and theories of basic physical or biological sciences.	Apply fundamental physical principles in the mathematical analysis of systems. Differentiate between quantitative problem solving and qualitative logical reasoning methods to analyze physical systems. Use critical thinking to apply appropriate physics frameworks to model systems. Use multiple representations, such as mathematical, physical, graphical, verbal, and experimental, along with sense-making strategies to analyze physical systems. Apply the theories of rotational mechanics, oscillations, waves, ray optics, and universal gravitation to answer questions about the physical universe.	Students write solutions to questions about physical systems using multiple representations in lecture, homework, and lab. Specifically, formative assessment is provided in a progression of pre- and post-lecture work informed by active peer learning during lecture time. Students are challenged to synthesize their knowledge in hand-written homework sets. Additionally, students explore physical phenomena during lab experiments.	Student achievement of this outcome is measured in formative assessment using homework and lab reports. The majority of summative assessment is provided by written responses to exam questions that ask students to answers questions about the physical world. Grades are determined by students ability to demonstrate mastery of the learning outcomes during all formative and summative assessments.

CLO	Subject	Activities	Assessment
Category Learning Outcome #2	How does the course align with or meet this specific outcome?	What assignments, class activities, discussions are used to address this outcome?	How is student achievement of this outcome formally measured?
Apply scientific methodology and demonstrate the ability to draw conclusions based on observation, analysis, and synthesis.	Identify the important mechanisms in the system, connecting theory to experiment. Set up experiments to measure physical quantities and record data to test a hypothesis. Develop skills to analyze experimental results with a multitude of techniques including fitting data with appropriate mathematical formulae, quantifying uncertainty, comparing empirical results with theory, and evaluation of the success of the hypothesis. Apply the theories of rotational mechanics, oscillations, waves, ray optics, and universal gravitation to experimentally analyze physical phenomena.	Students will use and build scientific skills through a combination of prescribed, discovery, and inquiry-based lab activities. The work is performed within a lab group. Group lab reports are created that document the hypothesis, design, data collection, and results of the experiment. Guiding questions are posed and students write explanations through a combination of hypothesis, test, and conclusion. Experiments include a study of rotational mechanics, simple harmonic oscillators, interference, diffraction, reflection, and refraction.	Student achievement of this outcome are measured through evaluation of lab reports. Specifically, how complete, clear, and correct writings and analysis convey mastery of the physical phenomena explored. Complete synthesis from theory to observation to conclusion to reflection must be presented in their work. Grades are assigned based on the quality of the work presented in their lab reports.

CLO	Subject	Activities	Assessment
Category Learning Outcome #3	How does the course align with or meet this specific outcome?	What assignments, class activities, discussions are used to address this outcome?	How is student achievement of this outcome formally measured?
Demonstrate connections with other subject areas.	Students solve problems where the framework is based in physics but the context is a diverse set of engineering disciplines. Specifically, the distribution of context types is intended to match the distribution of majors in the course. Mechanical, electrical, civil, structural, biological, and computer engineering applications are found throughout the curriculum. Students solve problems using a diverse set of mathematical disciplines. Algebra, geometry, trigonometry, and calculus are all required in order to solve complex problems. Examples include: torque analysis, stable vs. unstable equilibrium, chemical bonds, negative feedback loops, audio engineering, optical devices, and interplanetary travel.	Students write solutions to questions about physical systems from a wide variety of scientific fields using multiple representations in lecture, homework, and labs.	Student achievement of this outcome is measured in formative assessment using homework and lab reports. The majority of summative assessment is provided by written responses to exam questions that ask students to answers questions about the physical world. Grades are determined by students ability to demonstrate mastery of the learning outcomes during all formative and summative assessments.