

General Education Course Component Matrix

PHYS 103, Conceptual Physics

Department: Chemistry and Physics

Proposed Course Prefix/Number: PHYS 103

Course Title: Conceptual Physics

What General Education Goal is this course intended to address? **Goal 6**

Outcomes

Required Outcome for Goal 6	Relevant Course/Institutional Components (refer specifically to course syllabus)	Specific Assessment Method for Outcomes
1. Understand the major methods of natural science inquiry	<p><u>Lectures:</u> Throughout this course students will learn how the laws that govern nature were developed through experimentation. They will learn how scientists develop ideas and continue to expand on current theories.</p> <ul style="list-style-type: none"> • Week 1 – Chapters 1-2: development of science through experimentation verses philosophy; Aristotle verse Galileo method of scientific inquiry • Week 6 – Chapter 10: the Earth is not the center of the Universe; Kepler's Laws of Planetary Motion • Week 12 – Chapter 25: magnetism produces electricity, unifying the electricity and magnetism; Faraday's Law of 	<p><u>Exam questions:</u></p> <ul style="list-style-type: none"> • Exam 1: Essay questions regarding Galileo verse Aristotle's description and analysis of motion • Exam 2: Multiple choice question(s) regarding Kepler's Law of Planetary motion • Exam 3: Essay question describing Faraday's Law of Electromagnetic Induction and it's relevance to electricity and electrical power production. <p><u>Laboratory Analysis:</u> Students labs will be graded for completeness, correctness, and attention to detail.</p>

	<p style="text-align: center;">Electromagnetic Induction</p> <p><u>Laboratory:</u> Students will learn to make predictions, gather data, analyze data, and draw conclusions from their experiment. Some specific example of this are listed below; however all laboratory exercises will follow some aspects of the scientific method.</p> <ul style="list-style-type: none"> • Week 1 - Lab 1: Scientific Inquiry: learning to make predictions, take measurements, analyze data, produce relevant graphs to understand relationship between variables • Week 7 - Lab 6: Hooke's Law: analyze data through graphs, make predictions about motion 	<ul style="list-style-type: none"> • Experimental calculations will be graded for correctness • Percentage error will be considered as part of the attention to detail in an experiment • Conceptual questions at the conclusion of each lab will be graded to ensure the students' understanding of the experiment results <p><u>Homework:</u> Conceptual questions and problem solving will be graded for correctness. Each student will receive different numbers in their homework problems via WebAssign. Students will have multiple attempts on each homework problem to give ample time for students to learn and understand the material. WebAssign will grade the numerical problems and essays will be graded manual.</p> <p><u>Tracking/Reporting Exams, Labs, & Homework</u> will be graded. Tracking of mean, mode, and standard deviation on specific assignments/questions</p>
<p>2. Recognize and explain major contributions of science to our culture heritage</p>	<p><u>Lectures:</u> Throughout this course students will follow the development of scientific principles and ideas. They will see how the development of new ideas and new technologies changed our culture. Students</p>	<p><u>Exam questions:</u></p> <ul style="list-style-type: none"> • Exam 1: multiple choice/essay question regarding Newton's contribution to the way we view motion

	<p>will see that scientists offend had to change societies view of nature after centuries of incorrect assumptions and were offend outcast from society for their ideas.</p> <ul style="list-style-type: none"> • Weeks 1 & 2 – Chapters 2-5: Newton’s Laws of Motion changed the way we think about motion. Culture was forced to rethink what was believed to be absolute truth for centuries. The challenging of current ideas became accepted instead of ridiculed. • Week 6 – Chapter 10: Kepler also changed the culture of our society. The Earth is not center of the Universe. Culture’s belief regarding the heavens (Universe) and its relationship to religion was changed. • Week 6 – Chapter 11: The atomic nature of the atom helps us to better understand why materials behave as they do. We begin to see the development of new technologies, the atomic bomb, etc. Culture no longer looks to alchemist and superstitions. 	<ul style="list-style-type: none"> • Exam 2: Multiple choice/essay question regarding Kepler’s contribution to the challenging of ideas • Exam 2: Multiple choice/essay question regarding how understanding the atomic structure has influenced our use of materials and the development of new technologies <p><u>Tracking/Reporting</u> Exams will be graded. Tracking of mean, mode, and standard deviation on specific questions.</p>
<p>3. Understand how natural science has been used to address significant contemporary issues</p>	<p><u>Lectures:</u> During the course, students will understand how the development of new principles, theories, and laws, lead to new technologies that changed the way we lived.</p> <ul style="list-style-type: none"> • Week 4 – Chapter 7: Simple machines make difficult jobs of lifting heavy object 	<p><u>Exam Questions:</u></p> <ul style="list-style-type: none"> • Exam 3: Multiple choice/essay question regarding hydroelectric power production, electric generators, and electric circuits.

	<p>possible.</p> <ul style="list-style-type: none"> • Week 12 – Chapter 24: The theory of electromagnetic induction leads to hydroelectric power and mass production of electricity changing the way we conduct our daily lives. Communication in society becomes immediate via television in every household, cellular communication, the internet. • Week 11 – 12 – Chapters 22 – 23: Students will understand how and electrical circuit is built. They will understand the importance of electricity in our development as a society. • Week 13 – 14 – Chapters 26 & 28: The unification of electricity and magnetism lead to an understanding of electromagnetic waves and light. Fiber optic cable allows us to send information. Lenses allow us to correct vision and medical instruments like an MRI allow us to make accurate diagnosis. <p><u>Laboratory:</u></p> <ul style="list-style-type: none"> • Week 4 – Simple Machines: Students will study various simple machines from levers to pulleys. They will see that a machine makes the job easier by allowing an individual to apply less force to lift an object; however, to get the job done the same amount of work must be done 	<p><u>Laboratory Analysis:</u> Students labs will be graded for completeness, correctness, and attention to detail.</p> <ul style="list-style-type: none"> • Week 4 – Simple Machines: Essay questions will be given at the end of the lab exercise to ensure students understanding of the purpose of a simple machine. • Week 11 – Series & Parallel Circuits: Essay/short answer questions will be presented throughout the lab activity to lead students to an understanding of simple electrical circuits. • Week 12 – Magnetism: After building a small electric motor students will be asked an essay question in the analysis section regarding the use of an electric motor in our society. After studying electromagnetic induction, students will be asked an essay question regarding the production of electricity via hydroelectric power plants.
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	<p>regardless of the method or the machine.</p> <ul style="list-style-type: none"> • Week 11 – Series & Parallel Circuits: Students will build a simple electric circuit with light bulbs. They will understand the way in which we wire our homes with electricity as well as other electronic devices. • Week 12 – Magnetism: Students will study electromagnetic induction and will build an electric motor. 	<p><u>Tracking/Reporting Exam</u> & Labs will be graded. Tracking of mean, mode, and standard deviation on specific assignments/questions</p>
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General Education Criteria

General Education Criteria	Relevant Course Components (refer specifically to course syllabus)
<p>1. Teach a disciplinary mode of inquiry and provide students with practice in applying inquiry, critical thinking, problem solving</p>	<ul style="list-style-type: none"> • <u>Homework Sets 1-9</u>: Problem based homework will be administered through WebAssign. Students will be asked to apply their scientific knowledge to some basic problems that involve analyzing the given information, determining the appropriate concept and formula, and computing with some basic mathematics. • <u>Labs 1-11</u>: The laboratories are inquiry based activities with conceptual questions at the conclusion of the lab analysis designed to test the students' comprehension of the exercise. Students are asked to analyze data, make sample calculations, and produce reasonable percentage error in an experimental activity. More specifically, in Labs 1 & 6 students will be asked to use graphing techniques to analyze data and draw conclusion. In Lab 7, students must calculate the specific heat of a given substance using the data collected from the experiment and compare their experimental results to the known specific heat capacity of the substance.

<p>2. Provide examples of how disciplinary knowledge changes through creative applications of the chosen mode of inquiry</p>	<ul style="list-style-type: none"> • Students will learn the historical development of our current understanding of motion from the philosophical ideas of Aristotle to the experimental results of Galileo to Newton's Laws of Nature (<u>Week 1 – Chapters 1 & 2</u>). Students will understand the importance of the scientific model as compared to a philosophical approach to nature.
<p>3. Consider questions of ethical values</p>	<ul style="list-style-type: none"> • In <u>lab activities</u>, students will learn the ethics of scientific practice. Specifically, students will understand the importance of using data honestly especially when experimental result does not produce good results. Students will understand the importance of sharing scientific knowledge with the community and making it accessible to the general public.
<p>4. Explore past, current, and future implications of disciplinary knowledge</p>	<ul style="list-style-type: none"> • As technology is a major drive in our society today, students will explore and understand how technology has been developed through our understanding of physics. In <u>Chapters 22 – 25</u>, students will see how the unification of electricity and magnetism allowed for mass production of electricity. In <u>Chapter 28</u>, we will discuss total internal reflection and its importance in the creation of fiber optic cables. Students will learn that the development of new technology is dependent on the scientific discoveries of the past and the future.
<p>5. Encourage consideration of course content from diverse perspectives</p>	<ul style="list-style-type: none"> • Throughout the homework students will see that problems can be approached from various perspectives by using different concepts. For example, motion can be examined by describing velocity & acceleration or by using the concepts of momentum and energy. Students will be asked to solve problems of a similar nature using different techniques. • Students will see how different individuals throughout the history of physics approached problems. They will understand in Chapters 1 & 2 the importance of the scientific method as a means of developing and analyzing scientific theories as opposed to a strictly philosophical method. • Students will be asked to consider the development of technologies and their impact on our society. For example, as we discuss hydroelectric power, students will be asked to consider the advantages of electrical power as compared to the impacts on the natural habitat when a power plant is build.

	<p>Students will obvious have very different perspective on what is more important the natural habitat for wildlife or electricity for human consumption.</p>
<p>6. Provide opportunities for students to increase information literacy through contemporary techniques of gathering, manipulating, and analyzing information and data</p>	<ul style="list-style-type: none"> • Students will be exposed to many instruments during the lab activities. They will learn how to use varies techniques for gathering and analyzing data. <ul style="list-style-type: none"> ○ In <u>Lab 9</u> (Series & Parallel Circuits) students will learn how to use a multimeter to measure voltage and current in some simple circuits. They will analyze their results and make simple calculations. ○ In <u>Lab 6</u> (Hooke's Law) students will be asked to use Excel to create a graph of the data collected. They will learn how to do a linear fit of the graph and how the results are presented in Excel.
<p>7. Require at least one substantive written paper, oral report, or course journal and also require students to articulate information or ideas in their own words on tests and exams</p>	<ul style="list-style-type: none"> • Students will submit one/two complete <u>lab reports</u> which will include: Title, Purpose/Objective, Materials, Procedure, Observations & Data, Analysis of Data, & Conclusion. • Each exam will have essay questions in which students must synthesize their ideas and explain in their own words the concepts they have learned. • Homework assignments will often have one/two essay questions. These questions will be designed to make students process what they have learned in the reading assignments and lectures.
<p>8. Foster awareness of the common elements among disciplines and the interconnectedness of disciplines</p>	<ul style="list-style-type: none"> • Students will see the connections between physics, chemistry, & biology as well as connections to our social development. <ul style="list-style-type: none"> ○ In Chapter 11, students will explore our scientific understanding of the atom and how it has a great impact on our understanding of how material behave under various conditions such as the addition of internal energy, electricity, stress/strain, etc. ○ In Chapters 15 & 16, students will understand some of the anomalous behaviors of water and its impacts on life on our planet. Students will see the connections between our understanding of physics and biology. ○ In Chapters 12 & 15, students will see how understanding the stress & strain on a material as well its thermal properties affect they way we build structures in our society.

<p>9. Provide a rationale as to why knowledge of this discipline is important to the development of an educated citizen</p>	<ul style="list-style-type: none">• As we live in a world of technological advances that occur almost daily, it is important for citizens to be well versed in the language of science. Information is passed to the public quickly with the advent of internet and it is imperative that individuals are able to make well informed decisions regarding products, news events, and new technologies. Citizens need to be able to ask the appropriate questions and understand their answers. Having an understanding of the scientific method, having performed some basic experimentation and reported on the results, as well as having some base knowledge in the area of physics will hopefully help our students to ask the appropriate questions and understand if the answers have scientific merit.
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