Foundational Component Area: Life and Physical Sciences

In the box below, describe how this course meets the Foundational Component Area description for Life and Physical Sciences. Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.

The proposed course must contain all elements of the Foundational Component Area. How does the proposed course specifically address the Foundational Component Area definition above?

PHYS 208 (4 credits): ELECTRICITY
This course introduces the fundamental laws governing electricity and magnetism of objects, electric circuits and its functional principles. It is the second course in physics that follows the PHYS 218 Mechanics course for science and engineer majors. The students are taught the basic principles governing electricity and how these principles where first observed and developed by using the scientific methodology. It couples directly to current technology and its basics, particularly when related to basic circuit analysis. It requires a direct engagement by the student in order to learn to connect the theoretical concepts and tools with their own experience and with experimental laboratory exercises that reinforce the scientific method. The students learn how to evaluate the forces generated by charges, how to best model them mathematically and how they are related to basic electric circuits, electric motors, and other electro-magnetic based devices. Students taking this course learn the key arguments behind the scientific method and how to analyze and interpret what is being observed.

Core Objectives

Describe how the proposed course develops the required core objectives below by indicating how each learning objective will be addressed, what specific strategies will be used for each objective and how student learning of each objective will be evaluated.

The proposed course is required to contain each element of the Core Objective.

Critical Thinking (to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information):

This Core Objective is the primary one of the course. The students are continuously challenged to connect basic physical principles to predict new phenomena and to correctly model the behavior of mechanical systems. They learn how to synthesize a complex problem to its bare essentials that help them predict specific behavior and to critically assess the limitations of their predictions, e.g. induced magnetic fields by currents. The course incorporates active engagement through the use of i-Clickers that will challenge their conceptual understanding at each step of the way. The students watch a pre-lecture before the class room time and the bulk of the class time is spent challenging them to think critically on how the key physical principles are exploited to analyze different situations, predict phenomena, and create simple models for complex scenarios. This conceptual driven questions (i-Clickers) are then reinforced by context-rich problems in which a real life device related to basic science and engineering has to be analyzed, modeled based on sound scientific principles and appropriate assumptions.

Communication (to include effective development, interpretation and expression of ideas through written, oral and visual communication):

The students take a laboratory component to the course. In this laboratory exercise they will perform experiments to assess and solidify their understanding of electricity in different materials and basic circuit designing.
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They will compose scientific reports on their findings, learning how to defend their work in a scientific way. Oral communication between lab partners is an essential part of taking data, analyzing data and preparing a report. The first hour of the laboratory period is dedicated to recitation, where concepts presented in lecture and homework problems that apply these concepts are discussed among students. And, there is in-class discussion in the lecture portion of the course. Visual communication skills are developed in the course through the construction and interpretation of graphical presentations of data. Students are taught that constructing diagrams and sketches is an important component of problem solving. Written communication is developed by teaching students to present their solutions to problems in a clear and logical fashion. This is tested on exams. It is this scientific way of communicating that the students will take with them as a life-long skill.

Empirical and Quantitative Skills (to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions):

As a part of the laboratory and homework exercises, the students will be asked to test mechanics physics problems that are context rich. This means that they will be given a set of data and they will have to use the physical principles that they have learned in the class to analyze this data, predict subsequent behavior, and make accurate statements regarding error propagation and possible margin of error of their predictions.

Teamwork (to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal):

Similarly as in the previous PHYS 218 course, the students, throughout the lectures, will be periodically be asked pair-discuss-and-debate questions in which peer-instruction will be shown to produce better results than single student responses. As an example, during the pre-lectures that the students have to view on-line before the lecture the students are asked one or two concept questions and they have to write their logical reasoning for their answer. The instructor, at the beginning of the lecture, gives again the question with a set of multiple choices showing some of the best reasoned answers (some correct and some incorrect) and the students are asked to pair up, debate, and decide (through their i-Clickers) on the correct one by teaming with their neighbors. The result is always a better class average and as a result they learn the value of team learning and peer instruction, a necessary life-long learning skill.

Please be aware that instructors should be prepared to submit samples/examples of student work as part of the future course recertification process.