Department: PHYS

Course No.: 104Q

Credits: 4

Title: Physics of the Environment with Laboratory

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Content Area: CA 3 Science and Technology- Lab

WQ: Q only

Catalog Copy: PHYS-104Q. Physics of the Environment with Laboratory. Either semester. Four Credits. Three class periods and one 2-hour laboratory period. Recommended preparation: MATH 101 or equivalent. No previous knowledge of physics is assumed. Not open for credit to students who have passed PHYS 103Q .
Concepts of physics applied to the physical environment, particularly to current problems related to energy, transportation, and pollution. These relationships will be further explored in the laboratory section.

Course Information: - a). The goal of this course is to present the applications of physics to understanding the environment and our interactions with it, while giving students a clear picture of the role of quantitative models in science. While the course can have different emphasis, the current focus is on energy. The role of science in the wider domain of national energy policy is also briefly included: science, along with economics, is input to political considerations. b) The course typically requires reading and understanding of about 30 or so pages of the assigned text each week, supplemented by about two pages of web content. Typically eight to ten homework problems (conceptual questions and exercises from the text) are assigned each week. Solutions to the problems are posted on the Web. The quantitative part of each weekly quiz is based mainly on the homework, while the qualitative questions are from lecture or web-based material. In addition, students can discuss the problems (and other aspects of the course) with the professor in his/her office or go to the Physics Resource Learning Center for help from a graduate student. There are two hour exams given during the semester. The hour exams (as well as the final exam) consist of problems taken from the assigned homework problems (or minor modifications of them) as well as from the class notes. c) The physics involved ranges from Newton's Laws, through work to energy: mechanical, gravitational, electro-magnetic, chemical, thermal, and nuclear energy. We consider power, energy sources (fossil fuels, nuclear, hydro, solar, etc.), transformations of all kinds, and end uses. Side effects of this use, i.e. pollution and waste problems, the ozone hole and some natural optical phenomena (e.g. why the sky is blue) are also discussed at some depth. The place of models in science is emphasized, and their role in the current considerations on global warming, in particular, is discussed. Quantitative models are used where possible, giving rise to the use of a variety of mathematical forms suitable for non-science majors choosing a terminal course in physics.

Meets Goals of Gen Ed: Students are expected to acquire facts of the science involved, and to follow the construction of these facts into a body of knowledge that describes the technical world of energy. Examples such as the adiabatic lapse rate of a rising parcel of hot air, and the operation of a nuclear power plant, are used to demonstrate that science and its applications are coherent entities, not a collection of unrelated facts. Where possible, concrete models are used in parallel with more abstract ones, so as to facilitate the difficult task of assimilating the abstract. Acquire critical judgement. Students learn some of the rigor of scientific expression in that the units of a quantity are every bit as important in the expression of a quantity as the number associated with it. Likewise, in the expression of a scientific statement, as in the wording of a problem, every word has a precise meaning: mass is not weight, velocity is not acceleration. Where appropriate, answers must be checked against the common sense and common knowledge that students have. For example, a calculated per capita income of $10-4 per year in the US should alert the student to the fact that an error has been made. Acquire awareness of their era and society; The place that energy plays in modern society is pivotal. From cost, through transformation to end-use, manifestations of this abstract entity touches every person, every day. Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. The challenge of using "unknowable" numbers, e.g. 10-27, and operations involving them, is met with analogy and familiarity. We are particularly concerned with the problem of "math-phobia" that some students experience, and work to overcome this block. The method stressed is to use the most intuitive algorithms in solving problems, and to give students practice in the use of these algorithms. To pass this course students must learn how to translate the language of a word problem into the symbolic equations representing the situation depicted by the words. In the most favorable cases students will take this skill with them. At least three take-home tasks involving the use of the world-wide-web are assigned in each course. This practice is perhaps the most useful in giving students tools to continue to acquire knowledge.

CA3 Criteria: 1. Explore an area of science or technology by introducing students to a broad, coherent body of knowledge and contemporary scientific or technical methods; Energy, power and the environment constitute a body of knowledge made coherent by the circumstances of our material world. The subject is contemporary: rarely does a day go by without press reports on some aspect of the topics of the course. 2. Promote an understanding of the nature of modern scientific inquiry, the process of investigation, and the interplay of data, hypotheses, and principles in the development and application of scientific knowledge; The problems associated with our energy supply: of nuclear waste and of local and global pollution of the atmosphere, provide ideal vehicles to discuss the nature of modern scientific inquiry: how we know; why we believe. 3. Introduce students to unresolved questions in some area of science or technology and discuss how progress might be made in answering these questions; Unresolved questions introduced in this course: Given a world-wide rate of fossil fuel usage, by what amount will the mean earth temperature rise over the next decade? What will the deleterious effects of this temperature rise be? How might we ameliorate such temperature rise? These questions are discussed in class, and students get to visit some of the hundreds of web sites that contain the results of on-going research into these issues. 4. Promote interest, competence, and commitment to continued learning about contemporary science and technology and their impact upon the world and human society. The issues and facts that drive this course include our complete dependence on energy sources for our way of life, the finite nature of the energy supply, and of pollution. Problems caused by the interaction of these issues stimulate people to become, and to stay, educated about these issues.

CA3 Lab Criteria: The labs are of the inquiry type. With a minimum of instruction from the TA, the students work from lab manuals that just sketch what must be done, i.e., not a recipe-book approach. Students are taught in groups of 3. A report, due for each experiment, is part worksheet type answers, part "free-form" answers and discussion. The TAs are grad students; one per class of 18 students. The TA starts the class with a brief (~5 mins) discussion of the apparatus. When confronted with student questions, the TA never gives an explicit answer, but replies in a manner between Socratic dialog and asking leading questions. Physics 104 Experiments Mass Density Sink & Float Solar Constant Dew Point Thermal Properties of Matter Layering of Water Thermal Insulation Greenhouse Effect Spectra Radioactivity

Q Criteria: 1. Include mathematics and/or statistics at or above the basic algebra level as an integral part of the course which is used throughout the course. The course cannot be presented without using the basic mathematics cited above. 2. Include use of basic algebraic concepts such as: formulas and functions, linear and quadratic equations and their graphs, systems of equations, polynomials, fractional expressions, exponents, powers and roots, problem solving and word problems. Formal abstract structures used in symbolic logic and other algebraic analyses are acceptable; The course requires the use of formulas and functions, linear equations and their graphs, quadratic equations, polynomials, fractional expressions, exponents, problem solving and word problems. 3. Require the student to understand and carry out actual mathematical and/or statistical manipulations, and relate them to whatever data might be provided in order to draw conclusions. Merely feeding numerical data into a program on a computer or a calculator to obtain a numerical result does not satisfy this requirement. Technology should be viewed as a tool to aid understanding and not as a driver of content. The assigned homework problems all require the use of mathematics. Most of the problems require careful thought and generally cannot be properly solved by "plugging" into a formula.

Role of Grad Students: The TAs are grad students; one per class of 18 students. The TA starts the class with a brief (~5 mins) discussion of the apparatus. When confronted with student questions, the TA never gives an explicit answer, but replies in a manner between Socratic dialog and asking leading questions.