Department: PHYS

Course No.: 152Q

Credits: 4

Title: Physics for Engineers II

Contact Person: G. Rawitscher

Content Area: CA 3 Science and Technology- Lab

WQ: Q only

Catalog Copy: 152Q. Physics for Engineers II Either semester. Four credits. Three class periods and one 3-hour laboratory period. Prerequisite: PHYS 151. Not open for credit to students who have passed PHYS 132 or 142. PHYS 152 may be taken for not more than 2 credits, with the permission of the instructor, by students who have received credit for PHYS 122. Electric and magnetic fields, electromagnetic waves, quantum effects, introduction to atomic physics.

Course Information: These descriptions (this and the ones below) are similar to the ones given for PHYS 152Q: .a) The goal of this course is to present the fundamentals of physics to the engineering students, which is the basis of many of the engineering subjects. The lectures and readings show how mathematics, up to and including the calculus, can successfully be used with the underlying physics. A major objective is to teach students how to apply mathematics to solving the problems and how the physics concepts are essential to understanding of the world around us and in particular as related to engineering. b) The course typically requires reading and understanding of about 30 or so pages of the assigned text each week. In the last few years many lecturers are starting to utilize Power Point presentations with lecture notes being “posted” on the web for students prior to the lecture. An Active Learning methods are incorporated into the Power Point lectures. More involved concepts and problems are discussed also in more traditional format in front of a chalkboard. Whenever available demonstrations are given within the lecture time. Typically eight to ten homework problems (from the text) are assigned each week. The problems are turned in, graded, and returned (a week later) to the students. Solutions to the problems are "posted" on the Web. 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 three "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). This course is aimed at providing a basic understanding of mechanics, wave motion, heat, electricity and magnetism, optics, and selected topics in modern physics to engineering students.

Meets Goals of Gen Ed: Acquire intellectual breadth and versatility. Students are expected to acquire knowledge about the fundamental laws determining the behavior of mechanical,

electrical, thermodynamic, atomic, etc. systems. The course covers a wide range of topics involving kinematics and dynamics of solid objects, concepts of work and energy, interactions of electrical charges, the origins of magnetic fields, the energy levels of hydrogen atoms, etc. Using the basic physics presented in the course and supplemented by mathematics students should be able to understand for an example: why the earth stays in its orbit, calculate the length of the year, understand why there is a resolution limit of an optical microscope, etc. Acquire critical judgement. An important point of the course involves discussions on the range of validity of the physical theories presented. As an example they should learn that the classical mechanics of our everyday world is not applicable to the hydrogen atom and will not correctly describe its behavior. They will learn how to critically use mathematics (3+4 may equal 5 for example when adding vectors). Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. Although the course presents fundamental physics in many cases it shows how to extend the concepts to more sophisticated problems. It also demonstrates the use of mathematics and students can see that it is applicable to other fields.

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; The subjects presented in the course (mechanics, wave motion, heat, electricity and magnetism, optics, and selected topics in modern physics) cover a coherent body of knowledge. An understanding of them will certainly lead to an appreciation of many current scientific advances routinely discussed in the news. These scientific advances are basis for many developing technologies with a major impact in the engineering fields which is the main subject area for these students.

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; These points are routinely discussed in the lectures and in the texts used for physics courses.

3. Introduce students to unresolved questions in some area of science or technology and discuss how progress might be made in answering these questions; There are certainly unresolved questions. As an example it is pointed out in class that one of the basic laws in electricity and magnetism is that no isolated north or south magnetic poles exist in nature. From time to time an article is published which claims to have found an isolated pole. A flurry of activity ensues and the modifications to the theory are considered by theorists. The implications of the "finding" are discussed in class and it is also pointed out that the new experimental results could not be confirmed by other laboratories.

4. Promote interest, competence, and commitment to continued learning about contemporary science and technology and their impact upon the world and human society. Important discoveries in physics are mentioned in lecture when they appear in the news. This is intended to

promote interest and show the relevance of the field. Lectures by distinguished scientist and engineers at the forefront of physics and engineering hosted by Physics and sometime jointly with the Engineering school and which are suitable to the students are advertised in the class as a way to learn about the latest activities that may revolutionize or dramatically change current technologies.

CA3 Lab Criteria: The laboratory meets for three hours per week. The students, working in groups, do the following (hand's on) experiments. They analyze the experimental results, work out conclusions, and hand in individual laboratory reports. There is a laboratory final. Typical semester experiments are: Physics 151- 1. Introduction and error analysis 2. One dimensional motion 3. Forces 4. Energy 5. Momentum 6. Torque 7. Mechanical Oscillations 8. Waves 9. Energy Conservation Physics 152- 1. Ohm's Law: meters 2. Electric fields and Equipotentials 3. Electrical Resistance 4. Bridge Circuits 5. Oscilloscope 6. AC Circuits I 7. AC Circuits II 8. Faraday's Law 9. Interference of Waves 10. Mirrors and Lenses 11. Interference and Spectrometer.

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 a knowledge of calculus. Calculus is freely used in derivations and in working out illustrative problems during lecture. Calculus is also needed for solving homework problems and is integrated into the exam 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: Graduate students are responsible for the laboratory section of the course. They follow a syllabus prepared by the course "instructor" and give a brief lecture (~15 min) at the beginning of the laboratory class. The TA then assists and guides the students with their experimental work, and collects and grades the resulting reports. The TA is also available for students (outside of class) who may have questions about the laboratory work. The TA administers and grades the laboratory final and reports the laboratory grade to the course instructor. The TA's attend a special training session during the summer just prior to the start of classes and are supervised by the instructor and the department Manager of Laboratory Services. Graduate students are also assigned to grade the homework problems.