Department: PHYS

Course No.: 141Q

Credits: 4

Title: Fundamentals of Physics I

Contact: G. Rawitscher

Content Area: CA 3 Science and Technology- Lab

WQ: Q only

Catalog Copy: 141Q. Fundamentals of Physics I Second semester. Four credits. Three class periods and one 3-hour laboratory period. Recommended Preparation: MATH 101 or the equivalent. Also recommended preparation: MATH 113 or 115, or 120, any of which may be taken concurrently. MATH 120 is preferred for Physics majors. Not open for credit to students who have passed PHYS 131 or 151. May be taken for not more than three credits, with the permission of the instructor, by students who have received credit for PHYS 121. Fundamental principles of mechanics, statistical physics, and thermal physics. Basic concepts of calculus are used. This course is recommended for prospective Physics majors.

Course Information: - .a). The goal of this course is to present the fundamentals of physics to students majoring in physics. 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 the methods that a physicist uses to discover, understand, and apply the fundamental principles that, in appropriate combinations, quantitatively explain natural phenomena.

b) The course typically requires reading and understanding of about 30 or so pages of the assigned text each week. The students are also expected to rewrite and fill in necessary details for the notes they take in class. Typically eight or nine 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 two or three "hour exams" given during the semester and a weekly quiz. The hour exams (as well as the final exam) consist of problems based on the assigned homework problems (or minor modifications of them) as well as from the class notes. The weekly quiz is on material discussed in the most recent lectures.

c). This course is aimed at providing a basic understanding of mechanics, wave motion, heat,

electricity and magnetism, optics, to students intended to become physicists. An important difference from the other introductory courses to Physics (with calculus) offered to non-majors, such as 131-2, 151-2, is the enhanced emphasis on the understanding of the basic principles, and on the derivation of the applications of these principles to specific phenomena. The aim is to empower the student to himself discover and tackle previously not understood phenomena.

Meets Goals of Gen Ed: The course is designed to help the student acquire an understanding of a) the basic physical principles developed through years of research, b) how physical phenomena are inter-linked through these principles, and c) expose the student to the method of analysis a scientist uses to quantitatively understand phenomena. The method combines unprejudiced observation with the analysis of the observed phenomena by means of mathematical equations. Students are expected to acquire knowledge about the fundamental laws determining the behavior of mechanical, electrical, thermodynamic, atomic, etc. systems, acquire critical judgement as well as the open-minded attitude needed to discard erroneous prejudices, and acquire a working understanding of the methods by which they can continue to acquire and use knowledge. 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

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) 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.

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 course is designed to expose the student to the method of analysis a scientist uses to quantitatively understand phenomena. The method combines unprejudiced observation with the analysis of the observed phenomena by means of mathematical equations. It also trains the student acquire the open-minded attitude needed to discard erroneous prejudices, and acquire a working understanding of the methods by which they can continue to acquire and use knowledge.

3. Introduce students to unresolved questions in some area of science or technology and discuss how progress might be made in answering these questions; and The instructor emphasizes the phenomena that are not well understood, or explains where progress has just been achieved. The information is taken from progressive journals such as Science or Nature 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, as explained above. This is intended to promote interest and show the relevance of the field.

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 141- 1. Introduction and error analysis 2. One dimensional motion 3. Forces 4. Energy 5. Momentum 6. Torque 7. Mechanical Oscillations 8. Energy Conservation Physics 142- 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. The course routinely uses calculus (obviously above the basic algebra level) both to describe the quantitative content of basic principles, and to solve problems that uses these principles. For example Kinematics cannot be fully apprehended without the mathematical concepts of derivatives or integrals. Similary, Maxwell's equations describing electromagnetism cannot be stated without the aid of mathematical operators such as contour and surface integrals, certain vector derivatives (divergence and curl), and the flux of a vector through an area. The latter operators are relegated to a later course, but their existence and meaning is already hinted at in the course. 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; Calculus is freely used in derivations and in working out illustrative problems during lecture. The solution of homework problems requires familiarity with the mathematical techniques described above (linear and quadratic equations and their graphs, systems of equations, polynomials, fractional expressions, exponents, powers and roots) 3. The course requires 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. This course assiduously discourages the "plug-in" mentality, more so than any of the other introductory basic physics courses

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 of record and the department Manager of Laboratory Services. Graduate students are also assigned to grade the homework problems.

Supplementary Information: The 141-2 course is similar in structure to the 131-2 course, and differs from it mainly in the enhanced emphasis on "understanding" and self-motivation, as made amply clear in the description above. There are far fewer students in the class and hence the Professor is more able to address the questions of individual students