Course title: **Physics For Future Presidents**

Course number: **PHYS-123**

Term: **Fall, 2017**. Meeting times and location TBA.

Course description:

Physics is the liberal arts of high technology. If you understand physics then arguments about technology, energy, nuclear (and otherwise) weapons, climate change, space exploration, and even health care will no longer be intimidating. This course teaches the physics needed to be an effective policy maker or world leader, but it is also appropriate for any citizen, since all citizens need to understand the world in which they live and work. This class will make the fundamental principles of physics comprehensible, and indeed usable, by people who are not in science or math related fields.

A major purpose of this class is to expose students to the scientific method. Students will understand how physical hypotheses are shaped by the collection and analysis of data. Several activities will enforce this including required readings, weekly written analyses of a subject in modern physics, and preparing and delivering presentations that include graphs or other visual presentation of data. Students' presentations will focus on the science involved in the topic and include quantitative as well as qualitative arguments

Prerequisites: No prior college level physics or science class is required. Students must be able to perform basic arithmetic (add, subtract, multiply, divide) at least on a calculator, should understand what a square root is, and how to compute exponents with a calculator. Students will have to understand scientific notation for very large and very small numbers, but this will be covered repeatedly in class.

Learning Outcomes:

The purpose of this course is for students to learn the principles of physics and scientific methodology that they need to be scientifically literate members of society with the ability to think critically about many important problems facing society and our country and to be able to discern when information or arguments are scientifically bogus and when they are not founded on rational bases. Students learn to understand and appreciate sound physical arguments, and to be unafraid to critique arguments that are unsound. This will happen through readings, class discussions, writing critiques of science reporting, and by working through some important chains of reasoning.

By the end of the class, students will:

1. Recognize and articulate the scientific method. The scientific method is a broadly successful collection of techniques for acquiring new knowledge. It consists of systematic experimentation (that is, observation and measurement) as well as the formulation of hypotheses that can be tested by experiments. A key feature of the scientific method is that the results of comparison of hypothetical predictions with experimental outcomes are then used to modify the hypotheses, leading to the correction of previous knowledge and the integration of understanding of the whole body of knowledge. Students will recognize the limits of scientific knowledge and how to think about what it means when scientific investigations tell us things.

2. Describe, discuss, and explain the fundamental principles of physics necessary for informed public policy decision-making. The principals considered in this class include energy and power and the physics of explosions; atoms and heat; gravity, force, and space; nuclei and radioactivity including chain reactions, nuclear reactors, and nuclear weapons; electricity and magnetism; waves, including earthquakes and music; visible and invisible light; quantum physics; relativity; and the nature and extent of the universe.

3. Determine which of the fundamental principles are relevant to given problems.

4. Think critically about problems and situations relevant to society by applying those principles.

5. Communicate, both orally and in writing, the physical underpinning of real world problems of relevance to society.

6. Make informed decisions in a highly technical world. An example of this is given in the preface of the book. During a dinnertime discussion of solar energy, a student was told (by a physicist!) that switching to solar power alone is unfeasible because the area of solar cells needed to power the state of California alone would exceed the area of California. Knowing only the rough magnitude of the solar constant and a feel for the efficiency of solar cells, the student was able to refute the claim, which is off by many orders of magnitude.

Instructor:

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Textbook:

"Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know" by Richard A. Muller. ISBN: 9781400835317.

In addition we will make liberal use of the Internet for assigned reading.

Required material:

Students must purchase and register an iClicker. The iClickers will be used for in-class conceptual testing and polling.

Students must have a simple calculator that can add, subtract, multiply, divide, take square roots, and do exponentiation (x^y).

Grading Policy:

In-class quizzes (clickers)	20%
In-class presentations (grade based equally on clarity, accuracy, and teamwork)	20%
Homework	20%
Mid-term exam	20%
Final exam	20%

In-class quizzes will be short, multiple choice, questions that will focus the student on what is being discussed. These will be done with clickers, and will keep the students actively engaged during the class time.

In-class presentations: Students will work in teams to develop presentations on physical topics. These presentations will include graphs or other visual presentation of data. Presentations will focus on the science involved in the topic. Presentations should include quantitative as well as qualitative arguments. Each team will develop a sufficient number of topics so that each team member can lead a short discussion (about five minutes) in class. The grade will be based on the clarity of the presentation, the accuracy of the arguments, and the student's contribution to the team effort.

Homework: Each week students will find and read an article on physics or technology from a newspaper or magazine (online sources are allowed). It should be a serious article. Students will write a brief discussion of the physics involved and explain it, in their own words, as if they were science advisor to a policy maker. Homework grades will be based on clarity, accuracy, and proper choice of physical principles.

The mid-term exam will be given in class, and the final exam will be at the time scheduled by the university.

Grading Scale:

A: 90-100%
B: 80-89%
C: 70-79%
D: 60-69%
F: <60%

Attendance: Attendance is required.

Absences: If you miss an assignment or exam due to an authorized excused absence as outlined in the university rules, you should attempt to contact me prior to the day of the assignment, but no later than the next class meeting following the missed assignment to arrange to make up the missed assignment. Note: Few conditions qualify as an authorized excused absence, so you must avoid missing class except for extremely serious circumstances. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Course topics and schedule:

Week 1: Energy and power and the physics of explosions.

Week 2: Atoms and heat.

Week 3: Gravity, force, and space.

Week 4: Nuclei and radioactivity.

Week 5: Chain reactions, nuclear reactors, and nuclear weapons.

Week 6: Exam 1 and electricity and magnetism.

Week 7: More electricity and magnetism.

Week 8: Waves, including earthquakes and music.

Week 9: Light.

Week 10: Invisible light.

Week 11: Climate change.

Week 12: Quantum physics.

Week 13: Relativity.

Week 14: The Universe.

Americans with Disabilities Act (ADA) Policy Statement:

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit http://disability.tamu.edu.

Academic Integrity Statement:

The Aggie Honor Code states, "An Aggie does not lie, cheat, or steal or tolerate those who do." Further information regarding the Honor Council Rules and Procedures may be found on the web at http://aggiehonor.tamu.edu.

Bringing a friend's clicker to class to do his quizzes is cheating and is a violation of the Aggie Honor Code. This will result in loss of clicker points, and disciplinary action.

Request for reconsideration: PHYS-123, Physics for Future Presidents, for the core curriculum in Life and Physical Sciences.

We regret that our course materials gave the Coordinating Board the impression that our proposed course had the main focus of current events in the sciences, using back-of-the-envelope calculations, rather than a general education focus of academic study in the sciences using the scientific method, as required by the Life and Physical Sciences Foundational Component Area.

Indeed, our proposed course focuses on the scientific method and a critical understanding of fundamental and advanced topics in physics. Our proposed course is similar in many ways to PHYS-1310, which is already approved for the core curriculum. The similarities are in the way science is taught at the conceptual level without an advanced mathematical treatment. The principal difference is in the topics and the way they are introduced. PHYS-1310 teaches the very standard topics covered in introductory physics classes. Our proposed course goes beyond this to cover the important aspects of modern physics that need to be understood in today's society, and the topics (please see the syllabus) are rigorous and foundational aspects of physics.

Our course is ideally designed for students who may be considering careers in policy-making, and will teach them physics in a way that allows them to understand science and technology as it impacts decision making in a technological society.

We do not propose to use “back of the envelope” calculations. Although only simple algebraic manipulations and arithmetic are needed to use and understand the concepts we will teach, the students will learn the critical areas of academic study in physics. In our view, one of the most wonderful aspects of physics is that it can be learned and applied without advanced mathematics! In fact, in any advanced class in physics, professors usually emphasize learning the physics as well as doing calculations. Thus, the proposed class will teach the physics without the advanced mathematics that would preclude non-physicists from learning the material.

We believe this is an important class that can bring critical understanding of one of academia’s most basic sciences to a larger segment of the population. It is not watered down physics, or “physics for poets”. It will be advanced physics presented in a language that is accessible to all college students. It will teach them important science, but perhaps more importantly, it will teach them to use it.

Thank you for your consideration.

George R. Welch, Professor
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