This brief Syllabus summarizes the course content of Physics 401. The course reviews the concepts and progress of Physics from its beginnings in ancient Greece to recent developments in cosmology. We cover the necessary milestones: Galileo, Newton, the conservation laws, statistical mechanics and atomic theory of matter. We review heat, electromagnetism and light, the origin of quantum mechanics and its rapid growth to encompass so much of physics and other sciences. We briefly explore special and general relativity, and examine in some detail modern results in entanglement, particle physics, and other topics.

The approach is historical; the advances in physics are placed in context with historical and social developments that sometimes foster and at other times hinder the progress of science. For example we study why civilizations such as China, India, and Islam, have at one time or another led the world in much of Physics or mathematics, but have fallen behind after the Middle Ages.

Applied physics generally gets short shrift in any undergraduate curriculum. Since many physics majors may eventually work in an applied physics field, we devote a significant fraction of the course to that discipline. What we cover may vary from year to year, and depends to some extent on students’ interest, but usually includes such topics as medical physics, and radioactive dating. We will discuss particle accelerators from simple electrostatic machines, to various cyclotrons, synchrotrons, and linear accelerators. In this connection we take a half-day trip to the Oak Ridge National Laboratory to visit their most modern facility; the Spallation Neutron Source to see how it works, and how it enriches various areas of physics. We also discuss nuclear reactors, their advantages and problems for the production of energy. We also examine the issue of energy generally, it various ways of production, transportation and use, and we make a short foray into nuclear weaponry.

This is not a problem-solving course. The emphasis here is the development of ideas and concepts, on scientific themes and styles, the succession of important developments in what is now known as physics, with all its many branches and specialties.

The course will emphasize the importance of observation, experiment, and instrumentation. The history of Physics is not a succession of theoretical accomplishments, impressive as they are. It rests on measurement, understanding, sensitive equipment and instrumentation, and advances in mathematics.

Finally, we will examine the interplay between physics and society by discussing philosophical implications of physics, its relation to economics and government. We will also examine some case histories of scientific misconduct. This is an important topic in every physicist’s working life.

This is a course designed for senior physics majors. Students who do not fall into this category, for example philosophy majors or history majors with an interest in science have taken this course successfully in the past. Their lack of preparation in mathematics can frequently be compensated by their alternative skills. Physics is a quantitative science, facility with numbers and the ability to think quantitatively is a definite asset.

The textbook we will use is “Physics the Human Adventure” by Gerald Holton and Stephen G. Brush, Rutgers University Press, 2001. Much of the material we cover is in this book. Some additional material will be covered in “Class Notes”, and the rest I expect you to learn in class. There will be homework, but no final exam. Your grade will be based principally on homework, and also on class participation. If you would like more information, I can be reached at zuckeraje@aol.com.