PHYS 1905: How Things Work

Objective

Intended for students with little or no background in Science. Physics has an impact on all aspects of everyday life. This conceptual course looks at the physics behind everyday objects to learn about the basis for our modern technological world, and how new ideas will affect our future.

1. Transport: we take it as a basic right that we can travel considerable distances at will. However this consumes vast quantities of energy and is one of the major causes of pollution.What governs how efficient our cars can be? Are hybrid or plug-in cars the answer? Does public transport (buses and trains) use energy more efficiently?
2. Electricity: Our civilization is totally dependent on electrical power: the average human consumes around 1 kilo-watt, and demand will increase even as we try to conserve it. Various natural phenomena have triggered local failures of our power-supply. How does electricity work in the natural world? Where does our electrical power come from now? Will wind and solar power generate enough to replace fossil fuels? Is our system for distributing power adequately protected against natural disasters?
3. Weather and climate. Global warming is almost too well-known to require discussion, but most people have a very limited understanding on the underlying science. If we cannot predict the weather over more than a week, how can we hope to predict climate change of a century? If there are equations that describe the weather, why can't we predict where hurricanes will go? Why is carbon dioxide so important?
4. Radiation: this means many things, some good (such as light for communication, microwaves for cooking, infra-red for warmth) and bad (ultra-violet causes sunburn and skin cancer, nuclear radiation kills by damaging DNA). What is radiation, why is it usually safe, why do we need protection? How do X-rays and MRI machines show us the workings of our body? What happened at Chernobyl and Fukushima?
5. Quantum Mechanics: much of our technology, such as digital phones, cameras, computers and solar panels, depends on quantum mechanics. What does it mean? Why does it only (seem) to apply to tiny objects like electrons? Why should you care about giant-magneto resistance? Can we get an intuitive understanding?
6. Physics in the News: Every year there are news stories that show how vital physics is to our lives. Nobel prizes may seem to be awarded for incredibly esoteric work but they affect our lives in surprising ways. Why does a thin layer of carbon give us a totally new kind of

material, and what could we do with it? Why does it matter when the Higgs particle was found? Could we actually think of making an "invisibility cloak"?

Materials

- The recommended text-book for the course will be "**Conceptual Physics", 11th Edition by Hewitt**
- Notes will be published on the course web-site

Evaluation

1. (35%) on-line tests (using Moodle) approximately every week: a schedule will be published later.
2. (25%) An essay on a subject related to one of the above topics to be submitted before the last week of classes.
3. (10%) Midterm exam, multiple choice and covering the material in the first six weeks of term
4. (30%) Final exam will be multiple choice and will cover all of the topics above