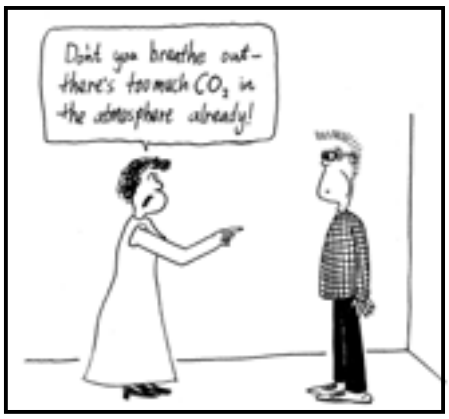
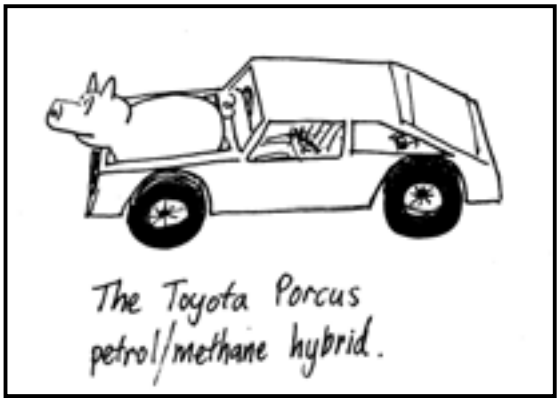
PHYS1211 Energy and Environmental Physics



The way modern society uses (and abuses) energy is the source of many of today's environmental problems, with air pollution and global warming being the best known. The laws of Physics say many important things about energy, from its overall conservation, to the modes by which it can be converted from one form to another, and the limits to the efficiency of such conversion processes. This course will look at the primary sources of energy available for human use, key conversion processes, and some of the possible environmental impacts of this use.

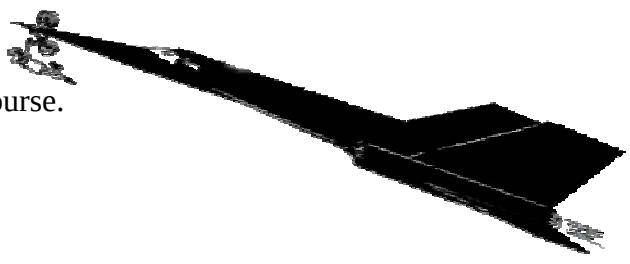
The second law of thermodynamics places fundamental limits on the efficiency of power stations and engines. Many of the more environmentally friendly energy sources have their own problems: Why has the promise of solar energy taken so long to be realized? Does nuclear energy have a future that is better than its past? How can science properly influence public/economic policy on energy?



This course covers a selection of key Physics topics which every Science and Engineering graduate should be familiar with.

Anyone with an interest in the environment and its protection will enjoy this course!

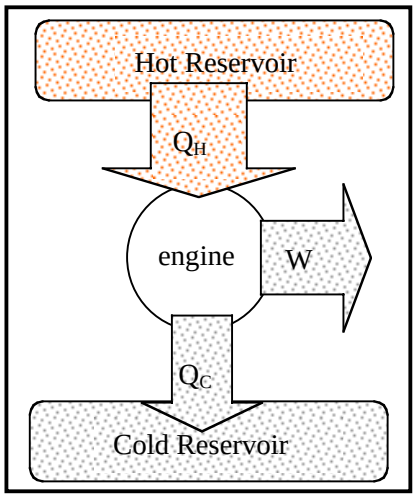
PHYS1249 Environmental Physics (Aviation) comprises Part 1 of this course.



Syllabus

Part 1: Classical Physics.

Introduction to forms of energy: How society uses energy. Transformations in the energy supply chain. Environmental concerns.



Heat energy and Thermodynamics. Thermodynamics of gases: ideal gas equation. Kinetic theory interpretation of pressure and temperature. Heat engines and the second law of thermodynamics. The Carnot cycle. Applications to heat pumps and refrigerators.

Energy conservation and storage. Thermal conductivity, insulation; applications to energy conservation.

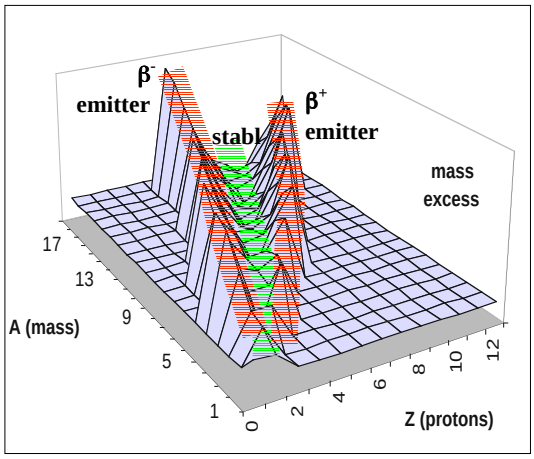
Fluid properties and applications.

Solar energy and its interactions: radiant energy and climate, solar thermal applications.

Alternative energy sources: Wind, wave, tidal, biomass and other sources.

Part 2: Quantum Physics.

Introduction to quantum concepts: photons, particle-waves. Energy bands in solids, conductors, insulators and semiconductors, doping. Photoelectric conversion, properties of different materials, applications. Fuel cells.



Nuclear science and technology. Properties of nuclei; protons and neutrons, binding energy, stable and unstable nuclei, liquid drop model. Alpha beta and gamma decay. Fission, fission reactors, breeder reactors, safety and environmental factors, fuel cycle and waste disposal. Fusion. Effects of radiation on living tissue, units, background radiation, radon. Applications of nuclear technology: nuclear medicine, radioactive dating, contaminant tracing.

Introduction to policy issues: demand side management, energy and carbon taxes, emissions trading.

Teaching

3 lectures, plus a 2 hour workshop-tutorial per week. These will provide the opportunity to get hands-on experience – of laboratory equipment, calculation techniques, and policy analysis. They will provide you with experience of both individual and team project work.

Assessment will consist of formal exams (mid-term and end of year), plus lab and project work.

Assumed Knowledge

A knowledge of Physics at HSC level (or equivalent – e.g. PHYS1111) is assumed.

Basic algebra will be used, and some simple calculus.

Textbook: R. A. Hinrichs and M. Kleinbach; Energy, Its Use and the Environment.