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DEPARTMENT OF PHYSICS AND ASTRONOMY

PHY123	***The Physics of Sustainable Energy***
Spring	***10 Credits***
Staff contact	**Prof Mark Geoghegan - mark.geoghegan@sheffield.ac.uk**

Outline Description	The module will cover the physics of sustainable energy. It includes discussions framed by the book `Sustainable Energy without the Hot Air' by D MacKay and will cover current energy requirements and what energy could potentially be provided by the various forms of renewable energy. The course will commence with a discussion of the basic physics of energy, power and work and the conversion of energy from one form to another. We examine in detail the history of global energy usage and how we produce and use energy in the UK. The course will then focus on the energy content of objects and processes we take for granted and will then move on to means by which we can produce energy using renewable technologies, such as wind, wave, tidal, solar, biofuels etc and water-pumping methods to store large amounts energy. We will also examine nuclear fission energy and will discuss their principles and practical implementation. We will consider other important solutions to our energy needs, including transportation, and energy conservation. The course will end by students putting together a road-map for the energy-future of the UK.
Restrictions	Students taking Physics, Physics and Astronomy, Chemistry, Electronic Engineering, Chemical Engineering and most physical sciences
Prerequisites	Maths and Physics
Co requisites	None
Approx Time allocation (hours)	Lectures - 18, Independent - 78
Assessment (%)	Coursework 100%, approx 3000 word Assessment is based on three assessments and two class-tests that are completed at various stages of the course. All assessments are completed on-line through MOLE. Class-tests are taken during a normal lecture. The assessments cover three themes: **1.** Embodied energy, energy needed in phase-transitions, human energy and CO2 emissions. **2.** Energy used in transportation, solar energy, heat-demands of a building **3.** Wind-energy, energy-storage and nuclear energy Assessment 1 requires the student to make reasoned estimates of energy content based on information taken from open-source literature and physical principles. Assessments 2 and 3 consist of numerical calculations. Assessment 1, 2 and 3 carry 20, 25 and 25% of the total mark. The two class tests are each based on simple numerical questions based on the use and generation of energy. The two class tests each carry 15% of the total marks.
Aims	The course aims to introduce students to the concepts of energy and energy use in modern technological societies, the problems with our current energy usage and possible solutions to produce and consume energy in a more sustainable fashion.

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Outcomes	**1.** The student should understand basic energy units and their conversion. **2.** The student will appreciate how energy is used and consumed both in history and currently in the UK. **3.** The student will understand the basic principles underlying a range of renewable energy generation technologies and their limitations and future implementation. **4.** The student will be confident in making basic quantitative estimates of energy usage, energy generation and the embodied energy in a number of basic processes.
Recommended Books	Sustainable Energy Without the Hot Air: David MacKay.
Syllabus	Lecture 1: Energy in society; how did we get here and where are we going? Lecture 2: Basic energy physics Lecture 3: Energy conversions Lecture 4: Energy in transport Lecture 5: Heating and lighting Lecture 6: Embodied energy Lecture 7: Energy in food Lecture 8: Class test 1 Lecture 9: Energy from the sun: photovoltaics Lecture 10: Energy from the sun: Bio-fuels and solar concentrators Lecture 11: Energy efficient buildings Lecture 12: Class test 2 Lecture 13: Wind energy Lecture 14: Waves and tides Lecture 15: Fluctuations and storage Lecture 16: Electrification of transport and heating Lecture 17: Nuclear energy, sustainability and safety Lecture 18: A plan that adds up?
Academic Notes	None