

PHYS1211 Energy and Environmental Physics

Syllabus

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

Weeks 1-7: Lecturer: Dr. G. Box

TOPIC	REFERENCE
INTRODUCTION; ENERGY FOR HUMAN USE How society uses energy. Energy transformations in the energy supply chain; chemical, nuclear, heat, mechanical, electrical. Key environmental concerns. Mechanical energy: force, work, kinetic and potential energy, PE diagrams, conservation of mechanical energy, bound systems.	Ch.1 Ch. 2 Ch. 3 Ch. 7 Ch. 8
HEAT ENERGY AND THERMODYNAMICS Thermodynamic variables, equation of state. Thermodynamics of gases. Ideal gas equation. Kinetic theory interpretation of pressure and temperature. Work, heat, and the first law of thermodynamics. Adiabatic lapse rate and pollution dispersal. Internal energy. Specific heat.	4.A-C 8.B
HEAT ENGINES AND THEIR APPLICATIONS Heat engines and the second law of thermodynamics. The Carnot cycle. Applications of the second law to various energy transformation processes: heat pumps and refrigerators; different engine cycles. Entropy and disorder. Emission of pollutants.	4.E-F 5.G 8.C-F
ENERGY CONSERVATION AND STORAGE Thermal conductivity, insulation; applications to energy conservation. Other measures for energy conservation. Energy storage.	4.D 5.B-C
SOLAR ENERGY AND ITS INTERACTIONS Radiant energy: laws of blackbody radiation. Solar energy distribution, interaction with atmospheric gases, effective temperature of the Earth, greenhouse effect. Solar thermal energy and its utilization.	6.A-H 9.B
FLUID PROPERTIES AND APPLICATIONS Fluid mechanics: continuity and Bernoulli equations; applications. Viscosity, Poiseuille's law, turbulence, viscous drag forces.	
ALTERNATIVE ENERGY SOURCES Wind, wave, and tidal energy. Biomass and other sources.	12.E 17.C

Note that these 7 weeks also constitute PHYS1249 Environmental Physics (Aviation).

Weeks 8-14: Lecturer: A/Prof M. Box

TOPIC	REFERENCE
INTRODUCTION TO QUANTUM CONCEPTS Photons, X-rays, photoelectric effect, de Broglie waves, Bohr atom, periodic table. Energy bands in solids; conductors, insulators and semiconductors, doping; superconductivity.	12.B 10.F
PHOTOVOLTAIC ENERGY Photoelectric energy conversion, properties of different materials, circuits and applications. Prospects for large-scale implementation of photovoltaic energy. Hydrogen economy, fuel cells.	12.A-D
PROPERTIES OF NUCLEI Protons and neutrons, binding energy, stable and unstable nuclei, liquid drop model, semi-empirical mass formula.	13.A-D 13.F
RADIOACTIVE DECAY PROCESSES Alpha, beta and gamma decay, valley of stability, energy levels; nuclear decay chains, natural radioactivity, radioactive dating; nuclear fission, spontaneous and induced, breeding, nuclear reactions; nuclear fusion, stellar nucleosynthesis, terrestrial power applications.	13.E 13.G-H Ch. 16
NUCLEAR FISSION REACTORS Fission reactor types, breeder reactors, reactor theory; operational, safety and environmental factors, reactor accidents, risk assessment, advanced reactor concepts; nuclear fuel cycle, recycling, proliferation concerns, waste disposal.	Ch. 14
INTERACTIONS OF NUCLEAR RADIATION Effects of radiation on living tissue, background radiation, radon; units for radiation exposure; applications of nuclear technology, nuclear medicine, contaminant tracing, ion beam analysis.	Ch. 15
ENERGY POLICY Introduction to policy issues. Demand side management, energy and carbon taxes, emissions trading.	

Note: Supplementary notes will be issued on most topics.