

PHYS1211 Energy and Environmental Physics

Syllabus

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

Part 1: Weeks 1-4: Lecturer: A/Prof Jeremy Bailey

Part 2: Weeks 5-8: Lecturer: Dr Krystyna Wilk

Part 3: Weeks 9-12: Lecturer: Dr Maurice Ripley

TOPIC	REFERENCE
PART 1	
INTRODUCTION TO ENERGY Importance of energy in science and society. Types of energy (mechanical, heat, chemical, nuclear, electrical). Law of conservation of energy. Energy transformations. Mechanical energy: force, work, kinetic and potential energy, PE diagrams, conservation of mechanical energy, bound systems. Electricity Basics.	Ch.1 Ch. 2 Ch. 3 Ch. 7 Ch. 8 Ch. 10
HEAT ENERGY AND KINETIC THEORY Heat and Temperature. Internal Energy, Specific Heat. Ideal gas equation. Kinetic theory interpretation of pressure and temperature. Work, heat, and the first law of thermodynamics. Adiabatic lapse rate. Radiant energy. Blackbody radiation.	4.A-C 8.B
ENERGY AND CLIMATE CHANGE Energy balance of the Earth. Greenhouse effect.. Climate feedbacks (water, clouds, ice albedo). Global Climate Models. Evidence for climate change. Paleoclimate. Climate change impacts. Climate change mitigation. Target CO ₂ levels.	6 B 9 A,B
ENERGY SOURCES Chemical energy. Energy in biology, photosynthesis, respiration. Energy use in the human body, energy content of food. Fossil fuels and their origin (coal, oil, natural gas). Problems with fossil fuels, greenhouse pollution, peak oil. Alternatives to fossil fuels.	Ch. 7 8. C,D 10. D,J
PART 2	
ELECTRICITY GENERATION AND TRANSMISSION Electrical power, generation of electricity, transmission of electrical energy.	10.C-H 11.B-C
THERMAL ASPECTS OF ENERGY GENERATION 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.	4.E-F 5.G 8.C-F

TOPIC	REFERENCE
SOLAR ENERGY Solar radiation. Solar thermal energy. Photoelectric energy conversion, properties of different materials, circuits and applications. Prospects for large-scale implementation of photovoltaic energy.	12.A-D
ALTERNATIVE ENERGY RESOURCES Wind energy, energy from water on land, ocean energy. Biomass and other sources.	12.E,F 17.C
<i>PART 3</i>	
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

Note: Supplementary notes will be issued on most topics.