Course Syllabus

Course Code: ELEC 0939

This six-week course for engineering students explores energy and sustainability, with a focus on new developments in energy efficiency and renewable energy technologies. The program is based on a ninety-hour combination of lectures, tutorials, laboratory work, demonstrations, site visits, computer simulations, assignments and discussion periods.

The University of New South Wales is recognized as the top university for energy R&D in Australia with many of the research groups among the world leaders in their field. Various UNSW lecturers will cover the following topics:

World Energy

This topic examines the international outlook for both traditional and renewable energy sources; energy, economic growth and the environment, implications of the Kyoto Protocol; and structural change in the electricity supply industry. A primary focus of the unit is the comparative economics of sustainable energy systems. A detailed analysis of projected US energy requirements through 2020, and their related environmental implications, will be based upon recent US Energy Information Administration estimates.

Energy and Environmental Implications

This topic will consider: The sources of the critical pollutants as defined by the EPA together with control strategies and forms of regulation; The concept of the environment as a closed system (i.e. spaceship earth) and the optimal level of pollution; The concept of environmental externalities and the use of market instruments to ensure that the polluter pays. Climate change and the Kyoto Protocol: science, economics, and politics will be considered in overlap with section 1. The impact of each of the renewable technology areas on environmental factors will be discussed in the appropriate unit of the course.

Energy and Sustainable Development

Our society's energy systems have a critical role to play in driving sustainable development. Key sustainability drivers are energy poverty in the developing world and the environmental harms of present energy systems. This topic first explores conventional fossil-fuel (coal, oil and gas) energy technologies and nuclear power. We then consider 'energy services' model for designing sustainable energy systems that are highly energy efficient and use renewable energy sources. There is a particular focus on sustainable energy technology innovation.

Energy and the Built Environment

Energy use in buildings, domestic and commercial; sustainable architecture; thermal comfort; passive design; energy performance modelling; building systems; HVAC and lighting in buildings. Computer simulations are used to highlight the effects of various design techniques on energy usage – glazing of windows, thermal storage, insulation, and ventilation.

Emerging Energy Technologies

There are a number of highly promising but, as yet, commercially unproven energy technologies which may play a very important role in our future energy systems over the longer term. We focus on emerging Carbon Capture and

Storage (CCS), geothermal, solar, proposed Generation IV nuclear power and hydrogen technologies.

Energy Storage

Energy storage systems include electrochemical, chemical and thermal. The principles of electrochemical energy systems and fundamentals of electrochemistry, secondary batteries and fuel cells are considered. The latest advanced batteries for stationary and mobile applications, including the vanadium redox flow battery, sodium sulphur, zinc-bromine, sodium metal chloride and nickel-hydride are discussed. Laboratory work includes battery design, testing and performance calculations.

Energy and the Process Industries

Process industries form the basis of modern society and will continue to play a major role. Research initiatives worldwide have paved the way for advancing the development of sustainable processes. Energy efficiency and waste utilisation are some of the key features of many of the sustainable processes that will be discussed.

Renewable Energy

This topic will cover the key renewable energy sources for sustainable energy systems:

(a) Biomass

Considers biomass and agricultural wastes in the production of alternative fuels. Ethanol production technology, from both yeasts and bacteria including genetically engineered micro-organisms (GMOs) and all the issues that this raises for large-scale ethanol production; methane via biogas technology; and other fuels via pyrolysis and combustion.

(b) Photovoltaic Devices and Systems

Will examine the basics of converting sunlight into electricity; the behaviour of solar cells; cell properties; system components; applications; grid connection; system design, including for RAPS (remote area power supply) applications. Experimental work will be carried out at the Photovoltaic Centre teaching laboratories where there are operating PV systems connected to the grid, solar pumping systems and where development work has taken place on the solar powered car.

(c) Wind Energy

Will describe the components of a wind turbine; examine the interaction of wind and rotor; consider fatigue; and examine the process of electricity generation and supply to the grid (wind farms).

Assessment

Students are required to attend all lectures and tutorials and to complete all assessment tasks. Failure to do so without legitimate reason will result in failure to graduate from the course.

Students will be assessed throughout the program. The assessment is in three parts:

(1) Each unit of the program will have some form of assessable activity. Questions will be assigned from the readings and class work.

(2) Essay and oral presentation. Students will be assigned in week 1, either as individuals or in small groups, to work on a project specifically in the area covered by the course. Students will write a report to be completed by week 5 and also make a short verbal presentation on the project.

(3) Final examination. A multiple-choice exam covering all course work will be given in the final week of the program.

All marking will be in accordance with the UNSW scale:

Fail	<50%
Pass	50-64%
Credit	65-74%
Distinction	75-84%
High Distinction	>85%

An international grade equivalence sheet will accompany the official UNSW transcript when mailed to the student following completion of the program.

Textbooks

A handbook of notes will be provided.

Course Information

'Energy Tomorrow: An Engineering and Management Perspective' is one of six programs that make up the UNSW Study Abroad Summer School in 2008. Each program has approximately 20-30 participants and all travel a similar itinerary within Australia with some having a course-specific field trip in week three or six. Generally, all groups will be staying at the same destination at approximately the same time, however programs will break up into their individual groups for classes and field excursions.

Location

The program commences in **Darwin**, in Australia's 'Top End'. While based in Darwin there will be a three-day camping expedition into Kakadu National Park, including a visit to Ranger uranium mine. Crocodiles, Aboriginal art sites and spectacular scenery are some of the highlights of this field trip.
On the way to Sydney from Darwin we make a brief stop in **Alice Springs** to visit the Centre of Appropriate Technology, then will move onto **Uluru**, the monolithic icon of the central 'red desert' region.

For weeks three through five, the program will be based at the campus of The University of New South Wales (UNSW), located 20 minutes from downtown **Sydney** and five minutes from the beachside suburb of Coogee.

Week six will be on location in **Cairns** for the final section of the course and a field excursion to a renewable energy site. This will leave a few days at the end of the course to relax and participate in the wide range of activities available in that area.

Program length

The course consists of 90 hours of class contact time over six weeks comprising lectures, laboratory work and related excursions. The program is valued at the equivalent of two classes (12 units of credit at UNSW; international equivalent of 6 or 8 units of credit, subject to home institution policy).

Program fee

The program fee includes:

- tuition
- all accommodation
- all meals in Kakadu National Park
- one dinner in Central Australia
- breakfasts and lunches in Sydney
- breakfasts in Cairns
- all excursion travel and entry fees
- orientation program and airport shuttle services
- UNSW student card (allowing access to all UNSW facilities).

Please note: Other meals and airfares are not included in the program fee.