SOLA1070

Sustainable Energy

Term 2, 2022

Course Overview

Staff Contact Details

Convenors

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Demonstrators

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School Contact Information

For current students, all enquiries for The School of Photovoltaics and Renewable Energy are managed by The Nucleus:

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Phone: (+61 2) 9385 8500 – Nucleus Student Hub

For future students, all enquiries for The School of Photovoltaics and Renewable Energy are managed by the Future Student Team:

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone: (+61 2) 9385 1844 – Future Students

Course Details

Units of Credit 6

Summary of the Course

Students will be introduced to the central concepts of energy and sustainability with a particular focus on sustainable energy systems through their use of the multiplayer ***PlayEnergy*** online simulation/game. Energy efficiency will be introduced as an effective way in which to conserve our natural fuel reserves and reduce environmental damage in a cost-effective way. This course will also introduce students to a range of renewable energy technologies such as photovoltaics, wind generators and solar thermal and allow them to explore ways in which these technologies and energy efficiency can be used to improve the sustainability of electrical power systems. Finally students will attempt to address the challenges involved in balancing between energy security (ability to meet demand), energy equity (affordability) and environmental sustainability in the design of an energy infrastructure for a community.

Course Aims

The course aims to introduce:

- The concept of sustainability and increase awareness of the different sustainability indicators and the challenges imposed by climate change and natural resource reserves.
- The concept of energy, energy conversion, and energy efficiency.
- A range of renewable energy technologies and develop an understanding in students of how these technologies can be used to improve the sustainability of electrical power systems.
- Expose students to the challenges involved in balancing between energy security (ability to meet demand), energy equity (affordability) and environmental sustainability in the design of an energy infrastructure for a community.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Identify the key economic and environmental sustainability indicators.	PE1.1, PE1.3, PE1.6, PE3.2, PE3.3
2. Describe the operation of a range of renewable energy technologies.	PE1.1, PE1.2, PE1.6, PE3.2
3. Perform calculations based on energy conversion and transfer processes.	PE1.1, PE1.2, PE2.1, PE2.2
4. Design an energy infrastructure by making decisions based on energy security (ability to meet demand), energy equity (affordability) and environmental sustainability.	PE1.1, PE1.2, PE1.6, PE3.2, PE3.3

Teaching Strategies

Please refer to the information in Moodle

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Online Quizzes	45%	Not Applicable	1, 2, 3, 4
2. Critical thinking assignment on sustainability	15%	29/07/2022 05:00 PM	1, 2, 3, 4
3. Final Exam	40%	Not Applicable	1, 2, 3, 4

Assessment 1: Online Quizzes

3 quizzes accessed online. A combination of timed and untimed quizzes.

This is not a Turnitin assignment

Assessment criteria

All quizzes will be on Moodle.
Question types include: multiple choice, calculations and short answer.
Multiple choice: Some multiple choice questions will have have several correct answers which need to be selected. Incorrect selections will attract a penalty, but you cannot get less than 0 for a given question.
Calculations: Full marks will be given for correct calculations and units (where applicable). If answers are incorrect the teaching team will check your working so that partial marks can be awarded. Calculation working should be shown in a programming format (preferably MATLAB). NO HAND-WRITTEN WORKING WILL BE ACCEPTED
Short answer: Provide your answers in the boxes provided.

Assessment 1.1: Online Quiz 1 (15%)

Start date: 10/06/2022 09:00 AM
Due date: 24/06/2022 05:00 PM
Deadline for absolute fail: 01/07/2022 05:00 PM
Quiz 1 is UNTIMED and covers material from weeks 1 & 2.
This is not a Turnitin assignment

Assessment 1.2: Online Quiz 2 (15%)

Start date: 15/07/2022 09:00 AM
Due date: 22/07/2022 05:00 PM
Deadline for absolute fail: 29/07/2022 05:00 PM
Quiz 2 is TIMED and covers material from weeks 3 - 7.
This is not a Turnitin assignment

Assessment 1.1: Online Quiz 3 (15%)

Start date: 29/07/2022 09:00 AM
Due date:05/08/2022 05:00 PM
Deadline for absolute fail: 12/08/2022 05:00 PM
Quiz 3 is TIMED and covers material from weeks 8 & 9 + overarching sustainability questions which combine all the information from the course.
This is not a Turnitin assignment

Assessment 2: Critical thinking assignment on sustainability

Start date: 01/07/2022 09:00 AM
Due date: 29/07/2022 05:00 PM
Deadline for absolute fail: 05/08/2022 05:00 PM

Written assignment on critical thinking with regards to an aspect of public debate

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Additional details

Written assignment (500 words) on critical thinking with regards to an aspect of public debate about sustainable energy generation. Details will be provided on Moodle

Assessment 3: Final Exam

Final exam

Assessment criteria

Final exam which will cover all course content. Details will be provided in the Week 10 Lecture.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

You should attend the lectures and one workshop per week. Please only attend the workshop which you are timetabled for.

While attendance isn't mandatory, you will struggle if you don't attend!

Class	Time	Location
Lecture	Tuesday 12pm-2pm	Matthews Theatre B
Workshop A	Wednesday 10am-12pm	Colombo LG01
Workshop B	Thursday 10am-12pm	Ainsworth G01

[View class timetable]

Timetable

Date	Type	Content
Week 1: 30 May - 3 June	Topic	**Introduction** • Course details • Start playing with PlayEnergy!
Week 2: 6 June - 10 June	Topic	**Energy & Thermodynamics** • Define the concepts of energy and power in terms of: (a) power applied over time; and (b) rate of energy flow. • Perform calculations using dimensional analysis to verify the above concepts. • Perform calculations based on energy conversion and transfer processes.
	Assessment	Quiz 1 opens!
	Reading	1. https://phet.colorado.edu/en/simulations/filter 2. University Physics, Volume 1 Chapters 1, 7, and 8 https://openstax.org/details/books/university-physics-volume-1 3. Lecture references
Week 3: 13 June - 17 June	Topic	**Energy Efficiency (Guest Lecturer: Prof. Alistair Sproul)**

		• Identify methods of reducing energy usage such as using low-energy whitegoods, appropriate building materials, and smart metering • Assess the effects of increased energy efficiency on lowering CO_2 emissions
	Reading	1. Lecture references
Week 4: 20 June - 24 June	Topic	**Solar Photovoltaic Power** • Explain why the entire solar spectrum cannot be harvested • Describe the dependence of solar radiation intensity on: time of day; time of year; and location. • Identify the energy conversion processes in a photovoltaic cell • Calculate the power and energy generated by a photovoltaic array considering derating factors • List the functions and desired properties of inverters
	Reading	1. https://www.pveducation.org/ 2. Lecture references
	Assessment	Quiz 1 is DUE!
	Assessment	Critical Thinking Writing Assignment opens!
Week 5: 27 June - 1 July	Topic	**Wind Power (Guest Lecturer: Dr Merlinde Kay)** • Explain the basic underlying science of wind energy, and engineering aspects of wind turbines. • Perform basic statistical analysis of wind data • Perform calculations of annual energy output and determine the capacity factor of a wind turbine • Have a good appreciation of some of the wider economic, social and environmental aspects of wind energy systems.
	Reading	1. *Wolf, E. L. (2018). Physics and technology of sustainable energy (First edition).* Oxford University Press. (Chapter 8) 2. Lecture references
	Assessment	Critical Thinking Written Assignment opens!

Week 6: 4 July - 8 July		Flexibility Week: No lectures or Workshops
Week 7: 11 July - 15 July	Topic	**Solar Thermal, Storage & The Electricity Grid (Guest Lecturer: A/Prof. Robert Taylor)** • Compare solar thermal to solar photovoltaics in terms of key metrics and feasible applications • Be able to explain and calculate the energy output of a solar thermal module as a function of direct and diffuse insolation, wind speed, ambient temperature, and operating temperature. • Be able to distinguish between different solar thermal technologies and their suitability to different environments/applications. • Describe the implications of implementing large-scale renewable energy technologies on the electricity grid. • Describe the current challenges facing energy storage technologies • Calculate required battery capacities and charging times
	Reading	1. https://www.eia.gov/tools/glossary/ 2. https://www.aemo.com.au/ 3. *Wolf, E. L. (2018). Physics and technology of sustainable energy (First edition).* Oxford University Press. (Chapters 9, 11.2)
	Assessment	Quiz 2 opens!
Week 8: 18 July - 22 July	Topic	**Economics** • Define, calculate and apply basic techno-economic parameters, including LCOE, the time value of money, and marginal cost of energy generation. • Describe the relationships between energy efficiency and costs of electricity
	Reading	1. Lecture references
	Assessment	Quiz 2 DUE!
Week 9: 25 July - 29 July	Topic	**Climate Change (Guest Lecturer: Prof. Jason Evans)** • Describe the potential impacts of CO_2

		emissions, and define and calculate related parameters such as CO_2 emission intensity. • Identify strengths and weaknesses in public and academic debate about climate change.
	Reading	1. https://www.ipcc.ch/ 2. Lecture references
	Assessment	Critical Thinking Writing Assignment is DUE!
	Assessment	Quiz 3 opens!
Week 10: 1 August - 5 August	Topic	**Sustainability** • Identify the dimensions of sustainability • Identify economic, environmental, and social sustainability indicators. • Discuss complementarities and conflicts between the dimensions of sustainability
	Reading	1. https://www.iea.org/sdg/ 2. https://www.un.org/sustainabledevelopment/ 3. Lecture references
	Assessment	Quiz 3 is DUE!

Resources

Prescribed Resources

UNSW Library website: https://www.library.unsw.edu.au/

Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Microsoft Teams: https://www.microsoft.com/en-au/microsoft-365/microsoft-teams/download-app

MATLAB Online: https://matlab.mathworks.com/

Recommended Resources

See Readings in the timetable section.

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include:

1. Slides updated with colour-coded backgrounds to identify examinable material
2. Increased the number of worked examples
3. Lecture notes available prior to lectures

Submission of Assessment Tasks

Work submitted late without an approved special consideration or extension by the course coordinator or delegated authority is subject to a late penalty of 5% mark reduction per day, capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, consistent with UNSW Assessment Implementation Procedure.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the ‘deadline for absolute fail’ is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or

b. Online quizzes where answers are released to students on completion, or

c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or

d. Pass/Fail assessment tasks.

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Important Links

All students are expected to read and be familiar with UNSW Guidelines and Polices. In particular, students should be familiar with the following:

· Attendance ·

· Special Consideration

· Equitable Learning Services

· Exams

· Approved Calculators

· UNSW Email Address

Disclaimer

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	